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Canada Parliament Senate
Special Committee
on senior policy,
Proceedings



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First Session—Twenty-eighth Parliament
1968-69

THE SENATE OF CANADA

PROCEEDINGS
OF THE
SPECIAL COMMITTEE
ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

The Honourable DONALD CAMERON, *Vice-Chairman*

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WEDNESDAY, JANUARY 29, 1969

WITNESSES:

National Research Council: Dr. William J. Schneider, President; Dr. K. F. Tupper, Vice-President (Administration); R. D. Hiscocks, Vice-President (Scientific); Dr. L. G. Cook, Délégué Général; Dr. W. H. Gauvin, Member and Manager, Noranda Research Centre at Pointe Claire, Québec; F. R. Thurston, Director, National Aeronautical Establishment; Dr. D. C. MacPhail, Director, Mechanical Engineering Division and Dr. William H. Cook, Executive Director.

APPENDIX:

22.—Brief submitted by the National Research Council.

The Queen's Printer, Ottawa, 1969

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird

Belisle

Bourget

Cameron

Desruisseaux

Grosart

Hays

Kinnear

Lamontagne

Lang

Leonard

MacKenzie

O'Leary (*Carleton*)

Phillips (*Prince*)

Robichaud

Sullivan

Thompson

Yuzk

Patrick J. Savoie,
Clerk of the Committee.



ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday,
September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the
Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted
for that of the Honourable Senator Argue on the list of Senators serving
on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative."

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

WEDNESDAY, January 29th, 1969

MORNING SITTING

(First Session)

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Aird, Bélisle, Bourget, Cameron, Grosart, Hays, Kinnear, Lang, Robichaud, Sullivan, Thompson and Yuzyk—13.

Present but not of the Committee: The Honourable Senator McGrand—1.

In attendance: Philip J. Pocock, Director of Research (Physical Science).

The following witnesses were heard:

NATIONAL RESEARCH COUNCIL:

Dr. William J. Schneider, President;

Dr. K. F. Tupper, Vice-President (Administration);

Dr. L. G. Cook, Délégué général;

F. R. Thurston, Director, National Aeronautical Establishment;

Dr. D. C. MacPhail, Director, Mechanical Engineering Division.

(A curriculum vitae of each witness follows these Minutes)

In attendance: Professor L. P. Bonneau, Member of the Council and Vice-Rector of Laval University.

At 12.50 p.m. the Committee adjourned until 3.00 p.m. this day.

AFTERNOON SITTING

(Second and Final Session)

The Committee resumed at 3.00 p.m., the Chairman, Senator Lamontagne, presiding.

Present: The Honourable Senators Lamontagne (*Chairman*), Aird, Cameron, Hays, Kinnear, Sullivan and Thompson—7.

Present but not of the Committee: The Honourable Senator McGrand—1.

In attendance: Philip J. Pocock, Director of Research (Physical Science).

The witnesses heard at the morning session were further questioned together with the following additional persons from the National Research Council:

R. D. Hiscocks, Vice-President (Scientific);

Dr. W. H. Gauvin, Member and Manager, Noranda Research Centre at Pointe Claire, Québec; and

Dr. William H. Cook, Executive Director.

(A curriculum vitae of each of the above persons follows these Minutes)

Also in attendance: Professor L. P. Bonneau, Member of the Council and Vice-Rector of Laval University.

The following is printed as Appendix No. 22: Brief submitted by the National Research Council.

At 5.35 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Schneider, William George, B.Sc., M. Sc., Ph.D., D.Sc., LL.D., F.R.S.C., F.R.S. Dr. Schneider was born in Wolseley, Saskatchewan in 1915. He received the B.Sc. in 1937 and the M.Sc. in 1939 from the University of Saskatchewan and the Ph.D. in 1941 in Physical Chemistry from McGill University. From 1941 to 1943, Dr. Schneider was a Research Associate at Harvard University on a Royal Society of Canada Fellowship. During the next three years he was a Research Physicist at the Oceanographic Institute at Woods Hole, Massachusetts, conducting research on the properties of underwater explosions and development of anti-submarine weapons. In 1946 he joined the staff of the National Research Council as Head of the General Physical Chemistry Section of the Division of Chemistry. During 1952-53 he was on leave of absence at Cambridge University where he worked in the theoretical chemistry laboratory with Sir John Lennard-Jones. Dr. Schneider was Director of the Division of Pure Chemistry from 1963 to 1966, and Vice-President (Scientific) of the National Research Council from 1965 until his appointment as President on 1 September 1967. He is a Fellow of the Royal Society of London, The Royal Society of Canada, and the Chemical Institute of Canada. He has been awarded the Chemical Institute of Canada Medal. The Honorary Doctor of Science degree has been conferred on him by York University, and the Honorary Doctor of Laws by the University of Alberta, and Laurentian University. He is a member of The Faraday Society, the American Chemical Society and the American Physical Society, and is a member of the Editorial Board of various scientific journals. Dr. Schneider has published 120 scientific papers and is co-author of the book 'High Resolution Nuclear Magnetic Resonance' by Pople, Schneider and Bernstein. Dr. Schneider has won international recognition for his contributions to the study of intermolecular forces and molecular properties. His work in high resolution proton magnetic resonance has resulted in a number of important contributions to structural chemistry, proton exchange behaviour and hydrogen bonding. He is also noted for his extensive studies of organic crystal semi-conductors.

TUPPER, Kenneth Franklin, O.B.E., B.A.Sc., S.M., D.Sc., LL.D., M.E.I.C. (Hon.), F.R.Ae.S. Dr. Tupper was born in Lynn, Massachusetts, in 1905. He obtained the B.A.Sc. degree in Mechanical Engineering from the University of Toronto in 1929. The same year he joined the National Research Council as a research engineer, employed in the design of wind tunnels and aeronautical research facilities. From 1944 to 1946 he was Chief Engineer at Turbo Research Limited, a crown company engaged in design and development of aircraft gas turbines. Dr. Tupper was then named Assistant Director of Research and subsequently Director of the Engineering Division at NRC's Atomic Energy Project (now Atomic Energy of Canada Limited). In 1949 he returned to the University of Toronto as Dean of Applied Science and Engineering. From 1954 until 1963 he was President of the consulting engineering firm of Ewbank, Tupper and Associates Limited, Toronto. Dr. Tupper was appointed Vice-President (Scientific) of the National Research Council of Canada on 1 January 1964.

Dr. Tupper is presently Vice-President (Administration) of the NRC of Canada. He holds an S.M. degree in Aeronautical Engineering from the University of Michigan, honorary D.Sc. degrees from Laval University, the University of Western Ontario and the University of Sherbrooke, and the honorary LL.D. degree from McMaster University. Dr. Tupper is an Honorary Member and Past President of the Engineering Institute of Canada, Vice-Chairman of the Board of Governors of the Ontario Research Foundation, and a Fellow of the Royal Aeronautical Society.

Gauvin, William H., B. Eng., M. Eng., Ph. D., D. Eng., F.C.I.C., P. Eng. Dr. Gauvin was born in Paris, France, in 1913. He received his early education in England, Belgium and France, and came to Canada in 1930 where he worked as a chemist for the next eight years. From 1938 to 1944 he attended McGill University, obtaining the B. Eng. in 1941 and M. Eng. in 1942. From 1942 to 1946 he lectured in the Chemical Engineering Department at McGill University, and obtained the Ph.D. there in 1944. From 1944 to 1946 he was Plant Superintendent with F. W. Horner Limited, Montreal, and the following year returned to McGill University as Associate Professor in the Department of Chemical Engineering. From 1951 to 1958 Dr. Gauvin served as consultant to the Pulp and Paper Research Institute of Canada. In 1958 he became head of the Chemical Engineering Division of the Institute, while teaching and directing research in the Chemical Engineering Department at McGill University. He joined the Noranda Group of Companies as Manager of the Noranda Research Centre at Pointe Claire, Quebec, in 1961, and continued to direct postgraduate research work at McGill University. Dr. Gauvin is a Fellow of the Chemical Institute of Canada, a past Member of the Council of the Engineering Institute of Canada, a Member of the American Institute of Chemical Engineers, the Institution of Chemical Engineers, the American Institute of Mining and Metallurgy, the Canadian Institute of Mining and Metallurgy, the Canadian Pulp and Paper Association, the Association of the Pulp and Paper Industry, the American Society for Engineering Education, and the Corporation of Professional Engineers of the Province of Quebec. In 1964 he was named a member of the National Research Council of Canada. Dr. Gauvin has published over seventy-five papers in the fields of electrochemistry, heat transfers, and particulate systems (technology of droplets and small particles) and has patents on a new chemical engineering processing technique (the Atomized Suspension Technique).

Cook, Dr. Leslie Gladstone (M.B.E., F.C.I.C.). Délégué Général for Policy and Planning, National Research Council from September 1968. Born in Paris, Ont., 1914. Education: Brantford Collegiate Institute and the University of Toronto (B.A. in Physics and Chemistry 1936, Gertrude Davis Exchange Fellowship); University of Berlin, Ph.D. 1938 (Kaiser Wilhelm Inst. fur Chemie); Postgraduate work, Cambridge University 1938-39. In 1940 Dr. Cook joined Aluminium Laboratories Ltd., Arvida, as Research Chemist and in 1942 was appointed Physicist in the Aluminium Laboratories Ltd. research laboratory at Kingston, Ont. In 1945 Dr. Cook joined the staff of the National Research Council at Chalk River as a chemist on the design of the NRX reactor and the development of the Plutonium and Uranium 233 extraction Processes. In 1946 he

was appointed Head of Chemical Research at the NRC Atomic Energy Project, and in 1954 became Director of the Chemistry and Metallurgy Division of Atomic Energy of Canada Limited. In 1956 he joined the General Electric Research Laboratory in Schenectady, N.Y., as a Program and Project Analyst and in 1959 was appointed Manager of the Project Analysis and Program Planning Section of the General Electric Research Laboratory.

Thurston, Frank Russel. Director, National Aeronautical Establishment, National Research Council of Canada from January 1959. Born in Chicago, U.S.A., 1914. Education: University of London (B.Sc. in Physics, 1940). After graduating Mr. Thurston worked in the Engineering Division of the National Physical Laboratory, Teddington, England, before joining the National Research Council of Canada, Mechanical Engineering Division, in 1947. In 1949 Mr. Thurston was named Head of the Structures Laboratory, and in January 1959 was appointed the first Director of the National Aeronautical Establishment.

An Associate of the Institute of Physics, and Fellow of the Canadian Aeronautics and Space Institute, Mr. Thurston has served as Chairman and Member of a number of National and International committees dealing with aeronautical and space projects. He is the Canadian National Delegate to the Advisory Group for Aeronautical Research and Development (NATO); Canadian National Delegate to Commonwealth Advisory Aeronautical Research Council; Member of the National Committee of International Union for Theoretical and Applied Mechanics; Canadian Member of General Assembly of the Von Karman Institute (Belgium). He serves on the Technical Advisory Panel of the National Aeronautical Research Committee, and participates in the work of the Associate Committees on Space Research, Agricultural and Forestry Aviation, Structures and Materials, Aerodynamics, and other national groups.

Hiscocks, Richard D., M.B.E., B.A.Sc., P.Eng. Mr. Hiscocks was born in Toronto, Ontario, in 1914. He obtained the B.A.Sc. in Engineering Physics from the University of Toronto in 1938. He joined the National Research Council as a Structural Engineer in 1939 and, in 1944 was named Head of the Structures Laboratory, engaged in wind tunnel and aircraft design. In 1945 he joined deHavilland Canada as Chief Technical Engineer. Since that date he has held a number of senior engineering positions with deHavilland, and was Director of Future Projects and Research, deHavilland, Aircraft of Canada Limited. Mr. Hiscocks is currently Vice-President (Scientific) of NRC. For many years he lectured in aircraft design at the University of Toronto and is currently Scientific Advisor at that university's Institute of Aerophysics, with teaching responsibilities in the Graduate School. Mr. Hiscocks was awarded the M.B.E. in 1945, and the McCurdy Award in 1953. He is a Fellow of the Canadian Aeronautics and Space Institute, and a member of the AIAA, EIC and SAE. In 1967 he was named a member of the National Research Council of Canada. He is a member of the Advisory Council, Ryerson Polytechnical Institute; Society of Automotive Engineers, V/STOL Aircraft Committee; Past President, Canadian Aeronautics and Space Institute, and Past Chairman, Research and Development Committee, Aircraft Industries Association.

Cook, William H., B.Sc., M.Sc., Ph.D. Dr. Cook was born in Alnwick, England, in 1903. He obtained the B.Sc. in Agriculture from the University of Alberta in 1926 and also received an M.Sc. in Biochemistry in 1928. From 1926-28 Dr. Cook was a Research Assistant with the University of Alberta and joined the National Research Council staff in 1929 as a Research Scientist. He received a Ph.D. in Physical Chemistry from Stanford University in 1931. In 1941 Dr. Cook became Director of the Division of Biosciences and was a Fellow of the Royal Society of Canada in 1943 and Fellow of the Agricultural Institute of Canada in 1947. Dr. Cook is presently Executive Director of the NRC. In 1946 Dr. Cook was awarded the O.B.E. for distinguished leadership in wartime research. He was a Fellow of the Chemical Institute of Canada in 1959 and Fellow of the American Association for the Advancement of Science in 1965. Dr. Cook received a D.Sc. from University of Laval in 1963. Dr. Cook is a Charter member of the Institute of Food Technologists and a member of the Canadian Biochemical Society, Canadian Institute of Food Technology and the Biological Council of Canada.

MacPhail, Dr. Donald Campbell (M.I.A.S., F.C.A.S.I., F.R.Ae.S.). Director, Division of Mechanical Engineering, National Research Council of Canada from 1957. Born in Vancouver, British Columbia, 1915. Education: University of British Columbia (B.A.Sc. 1937); California Institute of Technology (M.S. 1938); Cambridge University (Ph.D. 1942). In 1940 Dr. MacPhail joined the Royal Aircraft Establishment in Farnborough, England and remained there until 1948—latterly in charge of the Supersonics Division. In 1948 Dr. MacPhail joined the staff of the National Research Council as Head of the Gas Dynamics Laboratory and Assistant Director of the Mechanical Engineering Division. Dr. MacPhail is a Past President of the Canadian Aeronautics and Space Institute (1959-60). He is the Canadian Executive Delegate for the Commonwealth Advisory Aeronautical Research Council.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

MORNING SITTING

(First Session)

Ottawa, Wednesday, January 29, 1969.

The Special Committee on Science Policy met this day at 10 a.m.

Senator Maurice Lamontagne (*Chairman*)
in the Chair.

The Chairman: Honourable senators, the National Research Council was the first among the government research agencies to appear before us some time ago. Now they are back with us inaugurating, as far as this committee is concerned, this new room. So, gentlemen, it would appear that you are always first in some respects.

We again have the pleasure of having with us Dr. William G. Schneider, President, National Research Council, and he is accompanied by Dr. K. F. Tupper, Vice-President in charge of administration; Professor Louis-Philippe Bonneau, Member, and Vice-Rector of Laval University, Dr. William H. Gauvin, Member, and Manager, Noranda Research Centre, Pointe Claire, Quebec, Dr. D. C. MacPhail, Director, Division of Mechanical Engineering, and Mr. F. R. Thurston, Director, National Aeronautical Establishment, National Research Council, and Dr. L. G. Cook, *délegué général* at the National Research Council. Some of us might like to know the origin of this title and also perhaps the functions which are behind this new bilingual word. Do you wish at this time to make some kind of opening statement again?

Dr. William G. Schneider, President, National Research Council: Thank you, Mr. Chairman. Honourable senators, I don't think I have very much to add to the report that we have presented. Taking up your comment about the functions of the *délegué général* I might just explain this first; this is a new position which has been created in the National Research Council because we felt a

very great need to have someone who has a specific responsibility to worry about project analysis, evaluation of programs, policy review and so on. All of us who have on-line responsibilities are so busy, and this includes the research directors, with day-to-day things that it is very difficult to find time to go off into a corner and think. Therefore we felt the need for a built-in group of this kind to serve this function on a continuing basis. We are very pleased we were able to get Dr. Cook to serve in this position. As you know, he was at one time head of the Chemistry Branch at Atomic Energy of Canada establishment and subsequently spent about 12 years, or so, with the General Electric Company at Schenectady, New York, where he served precisely this function and which he has discharged with distinction. I think we are extremely fortunate to be able to have him join the National Research Council to help us in this capacity.

The Chairman: Do I understand the designation "*délegué général*" is quite different in this case from what it is for the Quebec representative in Paris?

Dr. Schneider: Exactly. Perhaps I might explain we had difficulty finding a single title that would describe all these functions, and this was borrowed from the French *délégation générale*, and the head is called the *délegué général*. They are concerned with policies and programs in the science area.

If I might, I would like to make one other comment. We have tried to prepare this report along the lines that you had suggested, and while you said that we should provide up to 15 case histories, we have gone beyond this largely because when we started looking at this—and as you will see by looking at the cases, every one is different—if you want to obtain an overall picture of the decision-making and monitoring and so on each one is different. I think you also wanted a picture of

how science is done. Therefore we felt it might be useful to give a broader picture of this.

Unfortunately we were informed subsequently that there are a few cases where we forgot to put in dates. I apologize for this oversight and I can supply these where required.

I would also ask your permission at some time during these proceedings, Mr. Chairman, to correct some errors that have appeared in previous testimony, specifically testimony given by Dr. Solandt before this committee. I don't know when is the best time to do this. Perhaps you would like to leave it until some of these questions come up or perhaps you would like to have it done at the beginning.

The Chairman: I think it might be as well to put it on record at the beginning if you feel like it.

Dr. Schneider: I could deal with this, then. The first concerns counter-mortar radar which I believe you will see in Dr. Solandt's testimony that this was something that was started away back by the National Research Council and should have been cancelled and was cited as an example of a program that goes on and on and is never terminated although the program is no longer needed. This is quite in error and certainly misleading. If I might read into the record a correction on this which was prepared by Mr. W. C. Brown, who was the group leader of this particular project in the Radio and Electrical Engineering Division. If I may read this, Mr. Chairman:

You will note that by inference or direct allusion Dr. Solandt uses the counter-mortar radar project as illustrative of those "which have obviously failed and are not going to achieve their objective, or whose objective has been bypassed by some other action that may have happened in some other part of the world..." and that "keep on drifting away from their original mission-orientation towards being more broadly-based research in the same field but not really properly planned."

It is difficult to see how such misconceptions could arise in the case of the counter-mortar radar project. No project of our Section has been mission-oriented to a greater degree—all developments were specific for the radar and many

advances are fully documented for inclusion in the radar should the Army decide to raise its performance still further. It might be added that NRC involvement in both the original development and in the program of continuing improvement was at the request of DND, and was financially supported by the Department.

The radar met or exceeded all specifications and, following very successful trials of the NRC development model in 1954 and of the CAL-produced user-trial model in 1957, was declared standard to the Canadian Army on 9 January 1959. Far from being an "obvious failure" and "bypassed" by development elsewhere, the full order for 10 radars for Canada and one each for Germany and Italy were produced and delivered by August 1964. The Canadian radars are operationally deployed and continue to produce excellent weapon locations. By contrast both the USA and the United Kingdom are still involved in improvement programs to raise the performance of their sets to that achieved in 1957 by the Canadian radar, although they have greater numbers deployed.

Dr. Solandt further said "The National Research Council has been working on a counter-mortar radar since 1944 or 1945 and it was just cancelled."

The program was not cancelled; following Treasury Board approval of the Canadian order on June 29, 1961, Raytheon delivered the first production radar for acceptance trials on July 26, 1962, and it was shipped to Germany on September 7, 1962. The entire order was completed by August 1964 but vehicle mounting was delayed due to the failure of the Bobcat vehicle program and slow delivery of replacement U.S. armoured carriers. NRC voluntarily withdrew from all military radar development in 1965 after fulfilling its commitments to NDN for state-of-the-art improvements to aid the NATO sales effort.

Dr. Solandt contends: "I know that it would have been better to stop the whole thing many years ago, because first of all interest in the problem has grown less or almost disappeared—Nobody really wanted the answer, but they kept working at it on a small scale over the years and I am sure that had a bad effect on the

morale of the whole group that were working there, quite apart from the expenditure."

Interest in mortar location never grew less, in fact, it increased further with the beginning of the Vietnam war and mortar-radar development is now rated "top priority" in the U.S.A. and NATO specifications exist for new radars for this field. Canadian interest was such that DND funded at NRC the mission-oriented program of product improvement referred to earlier. This program developed parametric amplifiers, a storage tube display, high power transmitters and automatic test and protective circuitry well ahead of any foreign program in this field. Some of these have been incorporated with the result that the Canadian radar has better field performance than its competitors. Furthermore, the Canadian Army "wanted to answer" for our mortar radars are now deployed in Europe with our NATO troops. The continuing interest in mortar-radar development is confirmed by the fact that joint U.S.-Canadian studies were completed by Northern Electric Laboratories in Ottawa some time ago. The design of a "second-generation" radar of greatly reduced weight is now technically feasible and a joint project is receiving consideration in Canada and the United States.

To those of us deeply involved in the design of this radar, it is depressing to see such statements made a part of the public record of the Senate Committee. The morale of our group remained high throughout; in the 20 years devoted to the field, I recall only two engineers leaving the group for alternate employment. We believed, and still believe, that mortar-radar can reduce our military casualties dramatically and that it could, if deployed by UN observer teams, settle many of the border issues by placing the blame for initial attack where it properly belongs.

The Chairman: This shows that not only senators can err.

Senator Thompson: May I just clarify a point? You mentioned the Bobcat. I did not quite catch the relationship. The Bobcat was curtailed and then there was some new research with respect to your counter-mortar radar.

Dr. Schneider: Yes. You see, this radar was designed to be mounted on an armoured vehicle. This was initially conceived to be the Bobcat. When the Bobcat was curtailed, it was decided to procure an alternative armoured vehicle from the United States on which the radar was to be mounted, and there was some delay in procuring this alternative vehicle.

Senator Thompson: Thank you.

Dr. Schneider: If honourable senators are interested, I might mention an article which, since it has appeared in a civilian, technical journal, is not I am sure a military secret. It appeared in the journal *Microwaves*, and the article is entitled "Microwaves at War". It discusses the experience in Vietnam of the present United States equipment. From this article you will see that on most aspects the Canadian-developed radar system is superior to that being presently used in Vietnam. This is, of course, a matter of very great concern to the United States' armed forces.

Senator Grosart: Mr. Chairman, on that particular subject, I well recall the evidence of Dr. Solandt and also that of the Defence Research Board on counter-mortar radar. Far be it from me to get into the middle of a battle between scientists. However, Dr. Solandt not being here, it is fair to say that both he and the Defence Research Board placed the most emphasis on the fact that other NATO armed forces would not accept it, even admitting the superiority of our equipment. I think it is also fair to say that the document before us opens with these words:

This is an example of a technical subject that was an economic failure.

This was where, as I understand it, the stress of Dr. Solandt's remarks was placed. In their own comment here, the NRC point out these factors, and are critical of the lack of support received in marketing the Canadian project.

For example, on page 94, referring to the Bobcat project, they say that one of the reasons was the "lack of a well defined and closely co-ordinated effort to 'sell' the equipment in foreign markets."

As I recall the evidence, the reference there was the lack of co-ordination in Canada between the various agencies which seemed to be falling all over each other in trying to

move the scientific development into the technological development stage.

I point that out because, in a way, Dr. Solandt's comments and Mr. Brown's rebuttal go, to some extent, to the heart of the whole problem of science policy. I will be dealing with this later, because I have been asked to ask some questions, but at what point do you say that we should stop a project? At what point do we say, "Look, it is important to achieve a technical success, even if it is an economic failure." This may have been the point Dr. Solandt was making.

I will say no more on that at this time. I will be developing some points on the case histories here later.

The Chairman: If I remember, we stopped our questioning at that time when the representatives of the army more or less placed the responsibility for the economic failure on the Department of Industry.

Senator Grosart: That is right, and we commented at that time that there seemed to be something wrong here, when you could take a military-scientific development and leave the selling of it in the hands of people who were not military experts or who were not themselves involved in the development. That was apparently the situation on the surface, and your comments on page 94 now seem to follow that up, indicating that, apparently on the surface, it was just a very bad selling job on the part of Canada. I think this is something that is running through our whole expenditure on research and development. I will say no more on that at the moment.

The Chairman: Do you have something to add to this, Dr. Schneider?

Dr. Schneider: I could add to this, if you wish. I think, first of all, the assessment of these projects which are purely in the military field has ultimately to be done by military experts. That is to say, the importance to our defence cannot be assessed by scientists alone, but also needs military experts.

But I think also when you have a multinational organization such as NATO, naturally there are also a lot of national sensitivities and the question of pride, and it was, I believe, the intention when this project was originally started, that they would be able to supply other NATO partners with this equipment. This has not come about, but where the fault lies, I do not know.

There is one other point I want to mention. There is the 30-foot wind tunnel, which is also written up as one of our cases. Perhaps I do not need to discuss this now, but there was an implication there that the possibility of situating this outside Ottawa was not considered. This is not the case. It was considered very, very seriously and on the basis of evidence, the decision was ultimately made by the Government to locate it in Ottawa. We could go into more detail on this if you like, but this was also in error which we would like to correct for the record.

Senator Thompson: Mr. Chairman, regarding the wind tunnel, I understand Dr. Solandt's inference to be that it could be near the industrial sources, airplane manufacturers rather than in Montreal.

Dr. Schneider: As you will see in the case that we have written up here, there were proposals both from Toronto and from Montreal, even from universities and the ultimate decision, which was very carefully weighed, was based on purely economic factors, because to site it elsewhere would have meant providing a lot of additional costly services which already exist in Ottawa and it would have meant at least \$1 million more in cost.

The Chairman: Even if the cost has been higher would it not have been more useful in the long run to be close to industry?

Dr. Schneider: Can you satisfy all the industries at the same time?

Senator Grosart: Again, Dr. Schneider, you make it clear that that final decision was made by the Government?

Dr. Schneider: That is right.

Senator Grosart: That statement appears on page 136. You say the Government took it out of our hands and the Government made the decision on economic grounds or for reasons of security?

Dr. Schneider: Yes.

Senator Sullivan: It is a very good thing that the ultimate decision was economic in regard to the very fine apparatus NRC built for brain cooling and brain surgery and the spin-offs from it.

Dr. Schneider: I am glad Senator Grosart mentioned the matter of security which was also a consideration.

Senator Grosart: Well, Dr. Schneider and gentlemen, I hope the chairman would want me to express our thanks for the trouble you have gone to, to give us this additional information after we took up so much of your time in having you prepare and discuss your original presentation. As one who has read it carefully a few times I might say I find it a most useful document. These case histories, taken together, seem to raise the essential science policy decision questions that are bothering us and on which in due course I presume we will have to report.

I have been asked to run through the case histories briefly and pick out a few of these matters which are larger than the cases themselves and ask if you care to make some comment on them. Taking the introduction, first of all, I may make a more or less gratuitous comment. I think you are a little overly defensive here. The National Research Council has functions, obviously according to the statute, other than to maintain a benefit cost ratio which would be satisfactory even to the Treasury Board. I accept the case you made that pure science research may or may not pay off economically. The general proposition is that you cannot evaluate these projects because of the time lapse between initiation and innovation. Everybody really in business and everywhere else has that same problem. I do not think it is confined to scientific research.

In business too, projections are being made 20, 25 years ahead and product projections as well. Sometimes you are right and sometimes you are wrong, but it does not seem to me to make unnecessary first the very vital original assessment of the viability of any project and secondly, a continuing technical audit. Now, there are some remarks here I just do not think would be generally acceptable to people who have studied this problem. For example, on page 6:

Annual accounting fitted the buggy-whip business; it really makes little sense for a computer business and it makes no sense at all for research programs.

I ask you to tell me if I am wrong in saying that it is an exaggeration to say that it makes no sense at all and, secondly, even if it makes no sense is it not true that in our kind of democracy and our kind of dealing with public expenditures through annual estimates, it does make some sense from the public point of view to make a continuing annual account-

ing? I do not care whether you say it may be zero this year or that the benefits may be zero five years from now, but I do not think it is fair for NRC to brush off this whole question of technical audit as cavalierly as it appears to be brushed off here. Would you care to comment on that?

Dr. Schneider: Yes. I do not think the implication here was intended at all that we regard technical audits as unnecessary. Indeed, these are done on a continuous basis. They have to be done. You have to periodically review, is this projecting anywhere, does it still have the same promise it had when we first started it? Maybe it is progressing better than expectation, maybe we should be putting more resources into it. In this sense, there is a continuing technical audit, but as long as it shows promise it is never a clear-cut issue, yes or no, that we are going to chop it off or continue it.

I think one has to give it a reasonable period and a long enough time that if there is any promise there that it has a chance to find out whether it is feasible. It is from this point of view that one cannot say that at the end of the year we are going to cut it off. Now, it may be that for budgetary reasons, if there are other things that have turned up which look far more promising, or are more urgent, and therefore we have to put more resources there. Of course, then this one may have to be slowed down or possibly it has to be cut off, even though it still looks promising. I think the problem here really is that in any of these co-called technical audits it is never a clear-cut issue of go or no go. I mean, all of these projects may still hold a great deal of promise. I think the interpretation you have placed on this was not our intent in this case. I do not know whether perhaps Dr. Cook would like to add something to this.

Dr. L. G. Cook, Délégué Général, National Research Council: I support what Dr. Schneider has said. What the intent really was, here, was to think of examples. I can think of dozens where one has had to spend money in a continuing fashion for sometimes three, four and five years on a project, on a substantial scale, before one had any significant results at all which indicated whether you were going to succeed or not. At the end of the first year if one should ask, "Do you know what the accomplishments are?", you just have to admit that there have not been

any yet. You are asking a question at that point in time and there is just not an answer. I agree with you completely on the subject of technical audits. As a matter of fact, in my experience, the greatest weakness that we show is not doing adequate technical audits. I am speaking generally and not specially from NRC's point of view, but there is a great tendency not to look deeply into the implications of a program in advance. All too often one waits until seven or eight years have passed and some difficulties arise before examining it carefully and then finding out it would have been better if you had done this earlier. I am entirely in agreement on the question of technical audits and the sense of this was merely to point out the very great difficulty in technical programs of dealing strictly on an annual basis with accomplishments.

Senator Grosart: I agree entirely.

The Chairman: Is it true at the moment you deal, or in the immediate past you dealt, with these projects strictly on an annual basis? For instance, most departments now have to give five-year forecasts of their programs and expenditures and I am sure that you are doing at least the same thing. Therefore, while, of course, you have to prepare estimates for the coming year this estimate is part of at least a five-year forecast, because if there were serious reasons for this that it might be possible to arrange for that, but the annual accounting is perfectly compatible with that five or 10-year forecast.

Dr. Schneider: I think certainly the forecasts are useful but they are only a guide. Ultimately we have to live within this year's budget, and this means that some very difficult decisions have to be made. You have a wide collection of very promising projects and you have to decide which one shall continue. You have not enough money or resources to carry them all along, at least at their present levels, and it is a difficult decision to have to make as to which is more important. This is particularly the case since many of these are long-range projects and you do not have the information to enable you to say yes or no. There may be promising projects that you would like to keep alive even though they would have to be slowed down, and you would hate to cut them off because they may be very promising and important programs. It is a problem of living within a fixed budget on an annual basis.

Senator Grosart: I am very glad to have that explanation. The reason I raised the point is that I did not want this statement to stand. The statement was "The whole history of the economic impact of research of the last 50 years indicates that for a technological growth economy only 10-year accounting and budgeting make sense." Then the statement I quoted earlier follows. I didn't want the impression to be left that the NRC doesn't believe in annual accounting. You do, but you make the clear statement that it makes no sense at all. I agree that there is a misunderstanding because annual accounting is one thing but when you make an annual accounting it does not mean that you have to make an annual decision whether to go ahead with a project or terminate it. But of course you must make an annual accounting.

Dr. Schneider: I think this was not to be interpreted that NRC doesn't believe in annual accounting. We do. It is a general statement to emphasize the long-range nature of R & D which is a very difficult matter involving very difficult decisions.

Senator Aird: Will you in replying to this define what is a Procrustean bed? It says there "Normal accounting control rules are, for research programs, often a Procrustean bed." Quite apart from the specifics raised I would like to have a definition of that.

Senator Grosart: The phrase is used twice.

Dr. Schneider: Well, I am not an expert on Greek mythology. Would you like to do that, Dr. Cook?

Senator Grosart: He was a gentleman who took his victims and put them in a bed. If they were too short he stretched them and if they were too long he shrank them.

The Chairman: I am sure this is not restricted to mythology.

Senator Cameron: The author just liked the phrase.

Senator Grosart: Maybe the Procrustean bed should be the symbol of the Treasury Board.

Senator Aird: Or the Senate.

Dr. Cook: May I add to that, that my recollection is that he shortened his victims by cutting their legs off and he lengthened them by stretching them on the rack until they

were the right length. The result was that either way they died.

Senator Sullivan: I really feel that the National Research Council is being pressed too hard by my friend here.

The Chairman: No partisan politics, please.

Senator Sullivan: They are dealing with research and the most important statement they made was "This elusiveness of beginning and end is one of the baffling problems a director of research has to face." We are dealing with research that might involve a three-month, a 13-month or three-year project.

The Chairman: I think Senator Grosart would agree with that.

Senator Grosart: I agree, and I will have some compliments to pay to NRC as we go along. I am very much impressed, as I said earlier, with the 35 case histories, particularly the references throughout to projects in which Canada has received international recognition and is today an international leader. I am particularly impressed with the work the NRC is doing in helping Canada keep up its international agreements in such things as calibration and assessment of, say, defence production-sharing items—\$200 million worth. Obviously NRC is doing a tremendous job in this area. That brings up the question that runs in my mind through all the cases, namely the references to the impulse responsible for the initiation of the projects. It is rather interesting in going through the report to see in the 35 cases that the majority of the impulses was exterior—that is, referrals to the board. When I look at the 934 intramural projects—my arithmetic may be wrong but I got to 931 and then quit—it is obvious that this may not be the pattern of all projects undertaken by NRC. Can you give us some idea of the percentage of scientific projects which are referrals from other departments as against those initiated by a director or by a scientist within one of the branches of the council itself? What is the percentage?

Dr. Schneider: If you also include industry in other departments, then I would say that the ones that come from outside—the problems referred to us or problems that may come to our attention simply by talking with people in industry about problems where we find we may be able to help—then I would say that this would be the majority of cases. The other ones that originate from within

would be a minority. Again we have to remember that some of these would be longer-range projects and that there isn't a new project started every year, whereas the turnover in the shorter-term projects that come from industry would not have as long a duration and so there is a much bigger turnover here.

Senator Grosart: I raise this point because we have been told on many occasions that there is an imbalance in our total public expenditure on R & D and that the NRC has been in part responsible for weighting the balance on the side of government in-house R & D. Now obviously many things that might be regarded as in-house in your operations are not really in-house at all, even though in performance they are. Today we have a completely new picture of NRC as really being a service arm of many departments and agencies of government. Is that a correct estimate?

Dr. Schneider: Yes, I think this is true, and I think we have to remember that since NRC just doesn't have one single narrowly defined mission but rather a much broader mission we have to try as best we can to achieve some kind of balance over these various responsibilities.

I would like to say, if I may, Mr. Chairman, on this question, and this comes up so frequently that I think it is worth some discussion, that we hear very often statements that our research effort in Canada is out of balance. Well, I think we would all agree that it is out of balance. But why is it out of balance? The conclusion that is so frequently reached is that we are doing too much Government-in-house research. I do not accept that. I think we have to look at this in perspective.

First of all, these kinds of conclusions are drawn by comparing our efforts with what other countries are doing. We have to remember that Canada is not a country like the others. Canada is a young country with abundant natural resources and, quite naturally, a lot of Government-in-house research effort is devoted to developing these natural resources. You have Energy, Mines and Resources; Agriculture; Fisheries, Forestry and Rural Development and so on. This, of course, is more closely directed to primary industries. This was a beginning and had to be a first step.

When you actually look at it in spite of this and take the total of all Government-in-house research, compared to what other countries are doing, on a per capita basis, we are not spending more on Government-in-house research than other countries.

We all know why the imbalance is there. We are not doing sufficient research in industry. This is the thing that has to be corrected. I do not think you are going to solve the problem or improve the situation by tearing down what strengths we have in order to do this. I think what we have to do is build new strengths in the deficient areas.

Senator Grosart: Mr. Chairman, if I may, I would like very briefly to place on the record some of the referrals that I noticed in these 35 cases. For example, on page 69 there is the brain cooling for surgery, which is a referral from an Ottawa surgeon. The referral of the flight simulator, mentioned on pages 73 and 77, came as a request from manufacturers. The St. Lawrence waterway project was a reference from the Department of Transport. The Welland canal was from Energy, Mines and Resources, as it is now. There was also a reference there from the Canadian Committee on Food Preservation. The National Film Board asked the NRC to design a microwave drier. The railways drew the air brake problem to your attention as well as the hot box problem. The Department of Transport asked you to assume the responsibility for the St. Thérèse investigation. The Thermopane investigation—I mention Thermopane because that was one of the trade names involved there—was a request from CMHC for a report. The Associate Committee on National Building Codes referred to snow load problem to NRC.

I will not at the moment say who referred the radiation biology question, but I will have something to say about that in a moment, because I think that if ever there was justification for having a Minister of Science Policy, the whole justification is to be found in that one fantastic case.

In the matter of these referrals, looking at your Estimates, I see that various departments charge you—for instance, Public Works. Do you charge those departments back, or do you charge industries for the work you do for them?

Dr. Schneider: Perhaps I could ask Dr. Tupper to answer that question.

Dr. K. F. Tupper Vice-President (Administration) National Research Council: Mr. Chairman, I think Senator Grosart is perhaps misinterpreting the Estimates. At the beginning of each section of the Estimates there is a listing of the approximate value of services supplied by other departments at the cost of those other departments. There is no charge. This is so that the parliamentarians can see the total cost of the program, both the amount in the estimates to the department concerned and the value of services paid for by other departments that are provided to them. So there is no charge in general. Now, we do get charges occasionally from Public Works.

Senator Grosart: I am aware of that. I was using the word "charge" in the accounting sense. In the accounting sense it is a charge.

Dr. Tupper: Similarly, for much of the work we take on we do also charge the department that does the work. This is an arrangement made so whereby they place with us a financial encumbrance and we can charge against that financial encumbrance. This is a necessity, because in many cases, for instance, as in the case of flying aircraft in order to do aeromagnetic work, we have to pay for the fuel and the cost of operating the aircraft. If we do not get the additional revenue to meet the cost, we cannot undertake the program.

Senator Grosart: When the railways asked you to solve the hot box problem, for example, did you charge them any money for that?

Dr. Tupper: I am sorry, but I do not know the answer to that particular question. I suspect we did this as a problem of national interest at our own expense.

Senator Grosart: Where would that show? In the Public Accounts? Where would any revenue such as this show against the hundred odd million?

Dr. Tupper: It does show in the Public Accounts.

Senator Grosart: These retrievables would show there?

Dr. Tupper: Yes.

Senator Grosart: I did not have a chance to look at that.

Dr. Tupper: Our total revenues run in the order of approximately \$900,000 a year.

The Chairman: When industry, or say, an individual, comes to you with a problem and you accept it for investigation in order to try to find a solution to that problem for industry or the individual, do you usually charge for that?

Dr. Tupper: Mr. Chairman, the answer to that is both yes and no. If the results are of interest only to the person who comes to us and the information we give him is exclusive to him, we charge. If the problem is one of national interest and other people are going to benefit from the results, and we are going to publish the results, then we do not charge.

Senator Cameron: Does this not suggest that you have a pretty large contingency budget? You do not know how many of these requests you are going to get in a year.

Dr. Tupper: Consequently, Mr. Chairman, we cannot accept them all. We can only pick up an additional project, you might say, if we have just completed one.

Senator Aird: You make the decision your selves as to the disposition whether or not you get paid?

Dr. Tupper: Yes. That is correct, Mr. Chairman; we make the decision as to whether or not we get paid.

Senator Aird: There is no referral to the Government?

Dr. Tupper: I think, if it were a matter of very large sums of money, then on a question of principle would convey the thing through the President to the Minister so that he would know what was going on. Lots of these things are only in the area of a thousand dollars or so. This would be done entirely by the staff, just following our customary principle, which is, if we are going to publish and the results are going to be generally available, then there is no charge; but if the results are for one person only, then we charge.

Senator Aird: At the moment, you say, your annual revenues from this source are about \$900,000?

Dr. Tupper: Not just from that source; from many sources. We have revenue from the sale of publications; we have revenue from many minor services rendered.

Senator Aird: Would you have any measure of the disposition of funds over and beyond the \$900,000 that you would decide not to charge for?

Dr. Tupper: Mr. Chairman, if I interpret the senator's question correctly, it is how much of our total program paid for by the Parliamentary Vote is done at the request of people outside the National Research Council. That is the same question that Senator Grosart put to the President, except that dollars are involved here as compared with the number of projects.

Senator Aird: I would not necessarily relate it to dollars. I would relate it to percentage if it suits your purpose in answering.

Dr. Tupper: I am not lost.

Senator Aird: You now have a revenue of \$900,000 which was earned from these sources for the work that you do. In your agency you make a decision concerning other projects for which you do not charge. If you wish to measure it in dollars...

Dr. Tupper: This would run into many millions.

Senator Grosart: I think what we are both getting at, Mr. Chairman, is that the \$900,000 certainly does not represent in any way the actual value of projects done and completed for others by NRC and I think Senator Aird is suggesting that we should not leave the false impression that the \$900,000 is any kind of quantitative measurement of the cost ratio benefit of NRC work.

Senator Aird: This is correct, Mr. Chairman. Senator Grosart has helped explain my position and I once again give you the alternative. Would you have an approximate guess as to the percentage of your overall in-house laboratory costs?

Dr. Tupper: I would think this would certainly run perhaps 40 per cent of our total in-house laboratory costs. For instance, the whole Division of Building Research does very little that has not been referred to it from the outside. The division has a staff of 230 or 240 people and it costs several millions of dollars including salaries to operate per year and that is one whole division. If you pick up all of these and add them together I would think it might come to between one-third or two-fifths of the total cost.

Senator Aird: Thank you.

Dr. Schneider: If I might add something to this, I think you are raising some questions here which do involve certain principles and certainly these are ones that we are studying

very seriously. The two extremes would be that NRC becomes a purely contract research organization and simply takes in projects on contract. What this means is that this is proprietary information and belongs to the man who is paying for it, to one industry. The other way of doing it, if it is a kind of project that would be certainly of benefit to all industries in that sector in Canada, when NRC does it not on contract we can then make the results freely available. If any patents come out of this we can patent it and licence it and so on. It becomes a question of what the best kind of balance is. Obviously we have to do both, but the kind of decision that has to be made in individual cases is what ultimately would be the greatest benefit to the country in doing it one way or the other. These are not easy questions. Certainly we do contract work for some industries in special cases, but of course, it is quite clear all the information belongs to them and it is proprietary information.

Senator Grosart: I would start by saying that roughly half your budget is a mere transfer payment in your research grants to universities which over the last few years has run about 50 per cent of your budget in the estimates so that it is only the remaining \$60 million that we have to account for. Then I understand that you undertake obligations under various statutes, such as IRDIA, the Industrial Research Development and Incentive Act, and certainly under PAIT, the Program for Advancement of Industrial Technology. It is my understanding that you are doing some of the work for industry as well as for the Government where you undertake this substantial obligation under these acts; is that correct?

Dr. Schneider: No, I think this would not be correct.

Senator Grosart: You have some observations on this in the report.

Dr. Tupper: The senator is correct. I think we are mentioned under the legislation as being a body that can be turned to for opinion and advice in these matters and we do, in fact, serve the Department of Industry fairly extensively on the PAIT program and to some extent on the IRDIA program as advisers. This does not, in general, involve laboratory work. There may be an exception where we have to do experiments. In general this is an advisory service given to another department at their request.

The Chairman: In helping to assess the applications?

Dr. Tupper: Yes.

Senator Grosart: In other words, where industrial firms come to the Government under these various acts—and I mentioned the Adjustment Act under the Kennedy Round—you do important work for the Government in assessing those cases. Would you put a value on that? Does it take up a lot of time?

Dr. Tupper: No. Mr. Chairman, I would say this is a relatively trivial service in view of the large size of our organization. We would get in the case of the PAIT applications a copy of the material which is going to be put before the PAIT advisory committee. This is an inter-departmental committee to advise that minister, who has to administer the PAIT program. When that material is received in our organization we will send it to the people most likely to know the science of technology and the industry and get advice from them so that the NRC representative on that committee, Mr. Hiscocks, Vice-President, Scientific, who was recently appointed would have the opinions of the various staff members concerned and could take this advice to the committee. As a matter of time consumed, these applications are received by us only a day or two before the meeting and there are only a small number involved. It is not a large service in terms of scientific manpower.

Senator Grosart: Is there any overlapping or conflict between the responsibility that you assume to the Government in this and the responsibility, for example, that the Science Council or the Science Secretariat assumes? I mean, why would they ask you for advice? How does a government department decide whether to ask NRC or the Science Council or the Science Secretariat to assess this?

Dr. Schneider: We have to distinguish here between operational programs and purely advisory functions. The Science Council has a purely advisory function on science policy and so on, but is not concerned with operations of programs. This is simply our input here and is essentially technical help in connection with assessing applications. These are operational programs administered by the Department of Industry. It is not a question of conflicting with Science Council or policy.

Senator Grosart: I raise the question because we are concerned in this committee

with the essential problem of finding out where the Government should turn for input of science into science policy. When we look at organizations such as yours and those I have mentioned, it is very difficult for a layman to get a clear concept of the limitations of the various channels that lead in. The layman in the Cabinet at times are also confused as to the data and assessment of the data that comes before them when they have to make various important decisions.

Dr. Schneider: On this point, Senator Grosart, I think the outside world is confused. I was at a meeting of the pulp and paper industry, which is currently being held in Montreal and they asked a similar question, "If we have some idea on science policy, or prepare a brief or something about, let us say, industrial research, who should we go to? Should we go to this Senate committee or should we go to the Science Council or to any department or the NRC? We want to make an input; where should we make it?" I think there is a confusion here and of course at the moment things are rather confused we will admit.

Senator Aird: If we could take a specific case, such as on the methodology, where someone has made an application to PAIT and they wish \$250,000 for a research project some place, where does PAIT turn to?

Dr. Schneider: Well, PAIT is operated by the Department of Industry and Trade and Commerce. The PAIT application would go in the first instance to that department and they have advisory personnel and committees that will then assess and evaluate this and ultimately it would then go up for decision making.

Senator Aird: Following through on the mechanics involved in decision-making, supposing \$250,000 is granted and it goes some place in Ontario, perhaps under the Ontario Research Foundation which has an interest in it, what happens to the \$250,000? Is the control or supervision of it gone, or what is the methodology of the outgo?

Dr. Tupper: I think that question can only be directed to the Department of Industry.

The Chairman: The NRC would advise the department and I would presume that in those cases the Department of Industry would have to assume full responsibility not only on the final decision whether to accept the project but also on its monitoring.

Dr. Schneider: I think this question could be related to development under the Industrial Research Assistance program and Dr. Tupper could explain how monitoring is done in that case.

Dr. Tupper: There is a considerable difference between the two programs because they are non-overlapping. Let us take the IRA program administered by the National Research Council as it exists at the present time. It exists for the purpose of building up research teams in industry. Now it was the intention that the work will be performed in the industry, not in the government lab, not in the Ontario Research Foundation, and not in a university. Under that program the National Research Council receives an application and has to take a decision, again with the help of an interdepartmental advisory committee. The funds are to pay only the incremental direct salary cost for a finite period of years. This is not a transfer of the cost of on-going research in industry from industry to government, but assistance during the interim period of time in building up a research competence in industry. The monitoring there is done by the fact that the funds are awarded one year at a time so that there has to be an application for renewal each year and the committee will reconsider each project annually when the renewal application comes forward.

Senator Grosart: Here again we come to annual accounting.

Dr. Tupper: It is annual accounting, senator. And here the committee will have information from a person who is the liaison officer, a government scientist in many cases from the National Research Council, or from the Department of Agriculture, the Department of Energy, Mines and Resources, or from the Forest Products Laboratory or an appropriate government agency, who will make at least one visit per year to the industrial laboratory concerned to ascertain what progress is being made.

The Chairman: But in assessing these programs would you use the same procedures and criteria you use for your own projects?

Dr. Tupper: No, Mr. Chairman. The responsibility for choice of the research project lies with the industry. We are concerned, when we approve it, more with the scientific and technological soundness of it than with the question of business economics, what it will

cost to manufacture and how large the market is, et cetera. These aspects of it are left to the business as the Government does not have in general in its research laboratories or elsewhere experts in these business fields. We expect the business concerned to have them. The responsibility for determining whether the market climate has changed from one year to another which is very pertinent in deciding whether to carry the project on or not is not a concern of government. We are concerned with the progress they are making and whether the staff appears to be well recruited, whether the industry has met their responsibility by providing laboratory equipment and supplies and meeting overheads in an ample way and whether they have a complete set of resources including human resources.

Senator Grosart: When you have this extensive program and other programs where does the Industrial Institutes' research program fit in? It seems to me from the terms of reference it falls into your field. My concern here—and I think that a good many parliamentarians are concerned in this matter too,—is with the proliferation of agencies. We have now signed a nuclear non-proliferation treaty and I hope we will have such a treaty in regard to proliferating science policy establishments.

Dr. Schneider: I presume you are referring to the Industrial Research Institutes set up by the department of Industry. They have to take the responsibility for this. I am afraid this was not our decision. It is my understanding that these have been set up on a trial basis and the department is providing, for a limited period of time, certain organizational costs.

Senator Grosart: Subject, I would hope, to annual accounting. Now to run very quickly through No. 1, which deals with radio astronomy, and the first identification of sun spots as a source of intense radio emissions. That is on page 9. You say, "It can be used to confirm, or to disprove, the theory that the continents are drifting on the surface of the earth." Is this a world first on the part of NRC?

Dr. Schneider: The first identification of sun spots—I am not sure whether I can answer this, but certainly an antenna array to get the resolution was developed fairly early on by NRC laboratories. I am not sure whether it was a scientific first or not, but it

is a continuing program providing data on solar activity.

Dr. Tupper: I think the point is that while the relation between the intensity of radio noise and sun spot frequencies was known a long time ago, we had the first antenna array which would look at the sky through a small enough angle so that we could point the antenna at the dark spot on the sun and verify that the intense radio noise did in fact come from this spot.

Senator Grosart: This would be one of several cases where NRC is assuming a national Canadian obligation in an international project. I said I would pay some compliments to the NRC to keep Senator Sullivan happy. I think it is very important that we understand that here again NRC is undertaking responsibility that belongs to Canada as in some areas it belongs to industry and to departments. It seems to me it has put a completely new complexion on the activities of NRC. We can also see this when we consider enzymes and the work of the Department of Agriculture.

Dr. Schneider: There is a very close cooperation with the Department of Agriculture, but I might add that this is very exciting work. A group under Dr. Whitaker in our laboratories has developed a technique for isolating these enzymes and they were isolated from Ottawa soil bacteria. You will remember the myxin story of a few years ago. It was found that there were some other interesting extracts from these myxobacteria. Dr. Whitaker's group was then able to isolate these enzymes with some very excellent techniques, and so they were able to prepare some very pure samples of these various enzymes. This could be a very powerful technique because, if you know exactly what these enzymes do, and they have a very specific action, then you can also think of applications. Some look very promising, I might say.

Senator Grosart: This may have been an anti-social project, because I notice that enzymes are major additives in the detergents.

Dr. Schneider: This may, in fact, become a very big application.

Senator Grosart: It is going to be the basis of a fantastic advertising pitch headed by Mr. Arthur Godfrey.

The Chairman: Will you participate in this exercise?

Senator Grosart: No. I am out of the advertising business now. So I am spending my declining years in criticizing the excesses of which I was a part for many years.

Referring to the ultra high vacuum techniques, this raises the question—and I am not being chauvinistic in this—of the extent to which NRC work is benefitting other countries. I want to make it clear that naturally there has to be a flow both ways. There are several cases here, of which this is only one, where Canadian industry has for many reasons not responded. Very often it is big industry that seems to be deficient, and then you have to go out and find small industry to undertake it.

In this particular case, as I understand it from your brief, these vacuum gauges are being manufactured now in the United States and Germany. There is another one, where one of your successful projects turns up in Russian satellites. On this general principle, why does Canadian industry appear to have been so slow to pick up these bonanzas that you produce from time to time?

Dr. Schneider: I might say that this picture is changing. I think you can in fact see the change in the Ottawa area. A number of small firms are now starting up using NRC inventions and going into production in these very specialized areas. These areas are rather sophisticated technologically speaking. Of course, once they have something really good they have world-wide sale.

Senator Grosart: If I may correct myself, this is the one that got into the Russian satellite. On page 23 it says:

A copy of a miniature massspectrometer developed at NRC has been flown in Russian satellites and used to analyse the constitution of the atmosphere.

I do not think I would be accused of being chauvinistic, if I said that I wished it had not gone into the Russian satellites.

Dr. Schneider: Certainly the whole area of high vacuum technology is just beginning to develop and is perhaps slower developing in Canada than in the United States and in some other countries, but it is coming and I think we will see a whole new technology developing here. But you cannot stop the Russians from doing this with published material.

I might also point out that we have just received a book which has just been published called *The Physical Basis of Ultra High Vacuum*, by Redhead, Hobson and Kornelsen,

in which a lot of these principles are discussed.

Senator Grosart: Are those your people?

Dr. Schneider: Yes. This is the group who have been doing this work on this particular case history, and they have a world-wide reputation in this field and have done some very excellent work. Periodically, there are devices and instruments that can be developed from this, and, of course, they are patented, and we try through Canadian Patents and Development to find Canadian companies to licence. Sometimes this does not succeed, but I think the atmosphere or climate is beginning to change.

We are beginning to get more and more, but most often they are likely to be a small, specialized firm that will become interested and develop it rather than an existing large company, which has existing goals of its own and feels that this does not fit in with its pattern at the moment.

The Chairman: Very often in these cases, is there not a lack of communication? You people, for instance, find very interesting inventions and then the creators publish the results, more or less, and then forget about them. They are not interested in the problem any more and there is a gap there between these people who have the technology and know-how to go further and industry, which does not have that knowledge and know-how.

Dr. Schneider: I think there is a bit of both. Certainly I think the communications can be improved, and we are certainly going to make every effort to improve them. But, as you mentioned, there has to be a fertile ground in industry. There must be people there who are receptive to this, which means that people must be there who, first, understand what it is about, and, second, can see the possibilities.

This is improving. I think we see examples now of a number of small firms growing up around the Ottawa area and Toronto and Montreal, who are now taking up NRC inventions and putting them into production.

Senator Aird: Just on this point, Mr. Chairman, throughout your brief you make the point very strongly with emphasis that this depends on dedicated personnel and dedicated teams. When we had before us the Atomic Energy of Canada, we were concerned about the marketing side and whether or not the people being put together into these teams

had a marketing background, a marketing ability. Is it fair to suggest to you today that when you were putting together your teams of research and personnel you were searching for persons with marketing as well as technological and scientific ability so that the composite results coming out would be something that could in effect be turned over to the type of concern that you are talking about?

Dr. Schneider: It is very difficult to combine top-notch research and marketing expertise all in one person. In most of these cases we are working very closely with Canadian Patents and Development who are, if you like, our marketing body. Of course, the scientists in the laboratories are backing them up and having consultations with industries that might be interested and so on, but the Canadian Patents and Development are now becoming much more aggressive and are building up to do a much bigger selling job, and this will be better for everybody.

The Chairman: When they appeared before us they were complaining that they did not all the time receive the full co-operation of NRC and those who had made these invention, in trying to further develop these patents and see to it that they could be used.

Dr. Schneider: Another aspect we are considering is that some of these could be developed further. There comes a point when you say, "How much should we do in the laboratories and how much should be done in industry?"

The Chairman: They were prepared to pay you for this, apparently.

Dr. Schneider: So far as possible, we would prefer to see development contracts, and there is some money for promoting this now. We would like to see some money go to industry to build up the expertise there. If we do it all in our own laboratories, we will still have the problem of transferring the knowledge to industry. Unless people in industry become capable and knowledgeable and acquire the skills, they will not be able to follow it through.

Senator Grosart: Do you have marketing people of your own?

Dr. Schneider: Not as such. As I mentioned, of course, in some projects, where we are working with an industry, we depend on the expertise in the industry in that realm and apart from that, Canadian Patents and

Development. I think they intend to build up their staff. They are still understaffed to do this job effectively.

Senator Grosart: They would be limited to the patentable items. For example, if I may move on to 5, the oxidants and antioxidants.

Senator Cameron: May I ask a question?

The Chairman: In order to clarify the procedure for today, I understand that Senator Grosart has been asked to lead the discussion today because he had led the discussion also when the NRC first appeared before us. I know that he has a lot of questions, but I am sure that Senator Grosart would agree that, as he goes along, supplementary questions by other members of the committee could be raised.

Senator Grosart: Most certainly, Mr. Chairman. I am glad you raised that. I was asked to run through these and they take in the whole presentation. I would hope that members of the committee would move in after I have made a point or have anything they wish to add.

The Chairman: Then, you will continue?

Senator Grosart: Yes.

Senator Cameron: Mr. Chairman, on page 23 I note:

A copy of a miniature mass-spectrometer developed at NRC has been flown in Russian satellites...

I am curious, did the Russians pick this up, reading the literature which we know they do and we read some of theirs, of course, or did they acquire this by an official agreement? This is the point I am getting at.

Dr. Schneider: Not by an official agreement. Some of these things of course are not patented. You cannot patent ideas and principles. Mass-spectrometers have been around for a long time and they are huge things. The modifications may not necessarily be patentable. This was published in the literature and is available to everybody.

Senator Cameron: I was wondering if it had been done by some informal agreement, not a monetary agreement and if that had been the case to what extent is there a reciprocal contribution from them?

Dr. Schneider: We, of course, have full access to all the Russian scientific literature

and in addition to that, as you know, we have an exchange program with the Russian Academy of Sciences. Canadian scientists visit Russia and visit their laboratories and discuss scientific matters.

Senator Cameron: This is a good way of doing it. They did get this from reading the literature.

Senator Hays: How many of the people involved in this scientific research receive economic benefits and then decide—I think we had a witness here some time ago from Boston and he said they had many, many small industries sprouting out around Boston from the research industry. What percentage of the personnel in science research or in the various fields see these economic benefits and become involved in going to somebody with the resources to say, "Well, there is great economic benefit here and I want to be part of this factory."

Dr. Schneider: I do not know if I can give you an accurate percentage. You see so much of the staff of let us say the division of building research, or the aeronautical staff, is of course working with the industry regularly. They do not normally do a lot of patenting, but they certainly see the results of their work. In some of these other cases where there are some longer-range research projects and some invention comes along there are, of course, the routes that I have already mentioned in trying to transfer this to industry, and there is extensive discussion with the people who invented it and the people who obtained the licence and who are trying to manufacture it. Route 128 in Boston that you mentioned is the sort of thing we are beginning to see around the Ottawa area. Smaller firms are starting up and perhaps one of the most successful is Leigh Instruments which is now diversifying and growing very rapidly. It is these kinds of industries based on new technology that, if they have good management and want to diversify, can have a very high growth rate. These are usually industries that have come in where no industry existed before and no markets existed before so this is all gain as far as the economy is concerned.

A very recent one is Space Optics Ltd. which keeps in close contact with the NRC laboratories. This is a very desirable development. It is in these areas of new sophisticated technology where I think you have to get knowledgeable people. When you get into the production phase they need different kinds of people. It is not necessarily assembly line

production. They have to have good engineers and scientists of their own. As they get a foothold with this capability they can take up new and other inventions and develop some of their own and it can grow very rapidly.

Senator Cameron: Is not the expansion of the electronic industry in Southern California a very good illustration of this?

Dr. Schneider: We must be careful in comparing the United States. You could also mention Alabama. These are all very very extensive government programs, particularly space programs, which have sprouted a lot of these industries with contracts. It is much easier to start industry this way of course. Whether they will be viable in the long run remains a be seen unless they diversify and develop some other lines of their own.

Senator Grosart: Regarding the oxidants and anti-oxidants, this would appear to be the case where pure research was initiated in our own laboratories and then developed as your report says a \$20 million Canadian industry. It might be a good place to ask you about the general necessity of the impulse within your own laboratories. In this case five years ago the director of the applied chemistry division initiated a study and then came up with a new theory. This has now become an industrial development. How would the decision be made to go ahead with this flight into pure science?

Dr. Schneider: Here you come back to people and the alertness of the really good scientist who sees there is a very important problem here and then he will go to his director and say, "I think this is a very important problem, I think I have some ideas. Could we do some work on this?" I think you have to have a certain amount of this along with the other things we were talking about.

I might also point out, why are we today able to talk about putting up communication satellites. It is because there were some scientists in DRB and NRC who saw this as an important emerging new technology and interested themselves in it and decided they were going to attempt some space satellite experiments. As the result we have Alouette I and II and we were able to build up some expertise in an emerging new technology. I think one has to have the kind of atmosphere where this kind of initiative, on the part of good individual scientists can develop.

Senator Thompson: I noticed both the cases you mentioned in medicine, the vascular

suturing instrument and the brain cooling surgery, came from Ottawa surgeons. The suggestion is that because of the proximity of NRC these surgeons are able to sit down informally with scientists, or perhaps they are able to come to your offices. Dr. Sullivan, I am thinking of Toronto as being considered a place of great medical research.

The Chairman: It is so far away.

Senator Thompson: Do you reach out to such places as Toronto or Montreal in order to have further formal discussions?

Dr. Schneider: I think it is perhaps two things. Certainly one is the proximity, but I think also that people who are sufficiently knowledgeable know the type of expertise at NRC and this is more likely to come about with proximity. I was looking for Dr. MacPhail. I am afraid he has left. I wanted him to tell us perhaps a bit more exactly how this contact with the surgeons started. As I understand it the surgeon saw the problem in this case and wanted to come and discuss it and see if he could get some help and try out his idea as to whether it was feasible, and came to NRC and the division of mechanical engineering.

Senator Thompson: Would you suggest that across Canada, surgeons are aware they can have this facility.

Dr. Schneider: That is a good question and one that we keep asking ourselves. There is a very big problem here in having day-to-day contact not only with universities and industry but with other government laboratories. It is a communications problem. This is one that we are very conscious of. We are trying to do more but we don't have the staff. This calls for a fair number of people visiting and all our staff does a fair amount of visiting in industry and universities. I see Dr. MacPhail has come back. Would you like him to deal with this?

Senator Thompson: I would like to know what kind of method you have for informing surgeons of medical research.

Dr. Schneider: Mostly through reports and through the Medical Research Council and so on. This whole area of biomedical engineering is one that is emerging. Groups in various universities and hospitals and NRC and MRC are keeping in close contact on this, but the Medical Research Council would be the main lead in. Dr. MacPhail, the question arises as to how this contact started between the sur-

geons and your division in connection with the suturing device and brain cooling. Was this an original contact made by the surgeon with yourself or how did they come to know that the expertise was there?

Senator Grosart: Could we have it put on the record that before Senator Thompson's question we were dealing with cases Nos. 15 and 16, to be found on pages 67 to 73?

Dr. D. C. MacPhail, Director, Division of Mechanical Engineering, National Research Council: Mr. Chairman, I should remark that first of all over the whole part of the world of which we have cognizance, that is to say Russia, Western Europe, this continent and Japan, there has recently developed a liaison between the medical, surgical and engineering professions. This is a liaison which for a number of years has not really existed very actively except socially at best. In this country the sizes of the cities and the intimacy of relationships which may occur because of their size and the social structure is such that people meet one another casually. In the cases to which we have referred the surgeons in both cases made casual contact with us and the work to which we have referred was in both cases the outcome of previous contacts and previous developments.

Senator Sullivan: May I ask Dr. MacPhail a question at this stage? Referring to this vascular suturing instrument, which is an excellent device, may I ask if anyone has applied that to the suturing of nerves?

Dr. MacPhail: As far as I am aware this has not yet been applied to the suturing of nerves. It has been applied to the suturing of arteries, veins, and in the transplanting of valves and the suturing of ureters which has to do with the transplanting of kidneys. But as far as I am aware it has not been applied to nerves.

The Chairman: Before going on, Dr. Schneider, in connection with this problem of communications, would it not be worthwhile if you would manage to have occasionally one of your representatives, like yourself for instance, contact the Canadian Medical Association and seduce them into inviting you to speak to them?

Dr. Schneider: This does not need any seduction, I am afraid, It is just a question of finding enough time for any one person to do it.

The Chairman: Then you would be able to address all the most important people in the profession and tell them what you know of.

Dr. Schneider: I can tell you that I seize upon every possible opportunity to do so. In this connection I should mention that there is a Canadian association formed about two years ago of biomedical engineering people who have regular meetings. A group in our laboratories is quite active in this. They discuss these problems facing medical and surgical people and I think this is a good start. I think it will help the communications problem.

Senator Sullivan: I think there is a branch in the Royal College of Physicians and Surgeons.

Senator Hays: Is this not covered in the medical journals? It seems to me that these would be the media best suited to cover this.

Dr. Schneider: Certainly the medical people are becoming active. Here is one of the hybridized situations where you need a coming together of medical and engineering people and people in electronics. Medical people as a rule know very little of the engineering field.

Senator Sullivan: And I would add that engineering people know very little of the medical field.

Dr. Schneider: It is a situation where you need some kind of liaison to work these things out together.

Senator Hays: Maybe the affluent in Toronto have too many other things to do and they are not interested in this kind of thing so far as the medical profession is concerned.

The Chairman: Let us not get into a fight here.

Dr. Schneider: I think it would be unfair to suggest that they are not interested. The Medical Research Council is also active.

Senator Grosart: One interesting point that comes out of all this is that the means used for suturing—the equipment—the original batch of instruments were made in your own workshops. I notice you tend to speak of laboratories. Is there a distinction between laboratories and workshops? I get the impression you are in industry as well as in scientific research.

Dr. Schneider: I might mention that in Dr. McPhail's division we probably have the best machine shop in the country. We have all kinds of sophisticated machines for mechanical work. So the original prototype models were done here. This requires very precise work. Then there was a problem once it was patented and now there is a Montreal firm trying to produce it. We have given them a great deal of assistance because they have to acquire the techniques involved. It is rather difficult because it is on a small scale and is very precise. You might be interested in the name of this company in Montreal; it is called Preci-Tool Limited. This again is very specialized production.

Senator Grosart: But then you have workshops doing much larger operations. For example, the wind tunnels.

Dr. Schneider: Correct.

Senator Grosart: What is the extent of the workshops? Would you venture a guess as to the net worth? This is a Canadian asset which must be very valuable. How many people are in your factory?

Dr. Tupper: I will take a rough stab at that. I think the shop which is in the Division of Mechanical Engineering, on which we can get full detailed information from Dr. MacPhail who is with us, is probably our largest, and I think I am right in saying that it runs to about 80 people for the total personnel, with about \$2 million in investment in tools. We have another shop in the Division of Radio and Electrical Engineering which is somewhat smaller, and I would guess it is significantly lower in investment in tools. We have still another one that is part of the complex of wind tunnels at the Uplands Airport, and it would be smaller still. I understand there are 12 people in the personnel there with about a third of a million dollars in tools.

Those are probably the only shops that you could regard as sizeable shops. In order to conduct laboratory work, you have to have some shop facilities just around the corner because you are always needing to make something. These are very often rather primitive in their equipment, and perhaps with only two people in them. They are very small shops. There are a few specialized shops for doing things like glass-blowing, where you would have a skilled glass-blower who literally, might not be duplicated, at all in that area. He will take care of all of the glass-

blowing in the whole building, and perhaps even service buildings remote from that.

Senator Grosart: Might it be a fair guess that you have 150 to 200 employees on the workshop side?

Dr. Tupper: Yes.

Dr. Schneider: Skilled craftsmen, yes.

Senator Grosart: No. 6 on page 29 is the big problem of fatigue in metals. Your brief says that you have been working on this for at least 20 years. You have some tangible results—a saving of \$3 million to the Canadian Air Force and, in one particular case, a saving of \$2 million to industry. You conclude by saying that there is every indication that the industrial need for this kind of assistance from the National Research Council will continue unabated. My question is, how much of this research work on metal fatiguing is being done in industry in Canada? This seems to be one area where many industries should be doing a continuing job on this subject.

Dr. Schneider: On this point, since we have an expert here, would it be in order to ask Mr. Frank Thurston, the Director of the National Aeronautical Establishment under whose laboratory this work is done to comment?

Mr. F. R. Thurston, Director, National Aeronautical Establishment, National Research Council: The answer is very simple, sir: It is, effectively, zero.

Senator Grosart: I am very glad to have that on record.

The Chairman: With this new developing technology and the bringing-in of new raw materials, composite materials, such as are being developed now, it would seem to me that this kind of work becomes more and more essential and important than in the recent past. Would you agree with this?

Mr. Thurston: It is certainly true that there are a number of new materials arising of which companies in industry know nothing in the fatigue sense, and there will inevitably be a demand for more effort in the fatigue area; the only light that is being shone on it is the increasing interest by universities which NRC is supporting in the fatigue area.

Senator Thompson: May I get some clarification on this? Doctor, are you saying that the aircraft industry is not doing

research, for example, on the fatiguing of materials in wings and so on?

Mr. Thurston: Yes, sir, that is what I am saying. From time to time the aircraft industry tackles small jobs, but in the sense of a continuing research involvement in fatigue, there is none in the aircraft industry.

Senator Grosart: I think I will start taking trains.

Mr. Thurston: I should remark that I was referring to the aircraft industry of Canada.

Senator Cameron: Would it be true to say that the real interest in this development is a result of the crash of the *Comet* which was one of the most effective studies of metal fatiguing done up to that time?

Mr. Thurston: The *Comet* crashed due to a fatigue problem and a stressing problem that was not recognized at that time. If I may, I would like to get back to the earlier remark that implied one might be worried about flying in airplanes. I was talking about fatigue research. Of course, every aircraft company does a great deal of work in one way or another to do its utmost to ensure that there is no fatigue of its aircraft, Canadian or otherwise.

Senator Grosart: You mean the original manufacturers?

Mr. Thurston: Yes.

Senator Grosart: This means the Americans.

Mr. Thurston: No, sir. I do not mean that. I mean the Canadian companies that produce original Canadian-designed aircraft do their utmost to ensure that fatigue is under control.

Senator Grosart: How can you reconcile that statement with the statement you made a moment ago saying that the work done in fatiguing was zero.

Mr. Thurston: I was talking about research; not testing. Aircraft companies quite customarily do very extensive tests on their products.

Senator Grosart: The tests are after they are made.

Mr. Thurston: Well, tests are made to some extent before on components, and to some extent after on the complete structure.

Senator Thompson: Am I right in this, that there are regulations by DOT that after a certain period an aircraft is considered to be worn out on the basis of fatiguing after so many hours of flying? How is that established?

Mr. Thurston: Well, sir, there are two or three principles involved here. There are quite a number of aircraft which either in whole or in part are replaced on what is called a finite life basis. There is a specific number of hours involved and the thing is taken out of service. This is to some extent tempered by what is known as a fail-safe design procedure. This is based on the thought that if you know how the aircraft is going to fail, and it fails safe, that is, you can see cracks before they can affect the strength of the aircraft, then you have, in effect, a fail-safe design, and this is based on maintenance procedures and inspection. These two things are combined very often.

Senator Grosart: Mr. Chairman, just while we have Mr. Thurston here, I wonder if we could go to No. 30 which is on page 116, the interesting case of the Ste. Thérèse disaster that has been mentioned. Here we have the very interesting statement, first of all, that the Department of Transport asked NRC to take over the whole job because there was a team of professional talent in NRC not available under one organizational group anywhere in Canada. Again, it seems incredible to me that this should develop into a responsibility of NRC, because obviously somebody in Canada must take the responsibility of providing the facilities to investigate aircraft disasters.

Perhaps we could get a little more information on this. Who investigated the other aircraft accidents in Canada?

Dr. Schneider: Before I let Mr. Thurston speak to this, I would point out that we are talking here about the technical assistance primarily, because this was a very involved investigation which required experts in many areas, and the Department of Transport does not have people who are doing research from day to day in these kinds of areas.

Senator Grosart: I would point out that, according to the record, you put in 15 man years of time on this question.

Mr. Thurston: Several issues have been raised here, sir. Perhaps I might remark first

that I did say, and do say on the fifth line on page 117:

Legal responsibility for the investigation was, of course, vested in the statutory authority—the Department of Transport, but recognising the need for massive scientific assistance the Department of Transport requested the National Research Council to accept responsibility for the teams investigating the structure of the aircraft, the power plants and the electrical, radio, hydraulic and pneumatic systems.

The Department of Transport for years, of course, has done its own accident investigation and the significant difference between this particular crash and the main run of crashes that had happened was simply the size. It was the most savage and costly in life and equipment in an accident that has ever happened in Canada to this date. So the question which was resolved by the Deputy Minister of Transport was that it deserved and it got the strongest possible team of people. You ask in what way this team of talent differed from what the Department of Transport, itself, has and it of course has a technical accident investigation department.

Well, if I might give a simple example I think the point would be clearer. In our laboratories in recent years we have developed, with the aid of the electron microscope a capacity for the diagnosis of the circumstances of a fracture, which is really very good. It is a method that really leaves very little doubt in our minds as compared with the kind of procedures that have been employed and still are being employed generally. Now, this kind of equipment and this kind of skill, since they represent the forefront of a developing research activity of course are not available in other statutory organizations that are using the state-of-the-art. So when one throws research people of this kind into an accident investigation you are really drawing on everything you know to the limits of where you are in your research enterprises. It is in this sense, I say, that this kind of team could not have existed in organizations which are, in effect, working at the state-of-the-art.

Senator Thompson: What is the rationale that you are concentrated on? A team of aircraft investigators examined this accident that took place, as you say a brutal tragedy in aircraft. Let me put it this way, are you concentrating or have you looked at the automobile industry from the point of fatigue or

accidents? Why have you just selected aircraft?

Mr. Thurston: Sir, we have not just selected aircraft. It is a truism, I think, that the fatigue crash of an aircraft has or makes a kind of public impact that almost no other kind of accident does, and of course accidents in aircraft always have this publicity as a kind of penalty they pay for being aircraft; but the fact is that in the fatigue laboratory we investigate many things regarding fatigue from milk separators to bridge-structure fatigue. There is no limitation in our own minds on what fatigue problems we investigate. Those that come to us or appear to us to be particularly significant we do our best about.

There is one other issue that arises and that is the fatigue problem, itself, of aircraft. It is generally more complicated than the main run of fatigue problems. This arises from the fact that the loads on an aircraft are of various magnitude, applied in a sort of random sequence. This, you can see, is quite different from let us say the fatigue of a shaft which is rotating at constant revolutions and being loaded by a constant load.

It is also submitted to environmental aspects which other equipment may not have. There are corrosion phenomena and there may be high temperature in the future. This conglomeration of environmental effects upon fatigue really makes it probably the most difficult fatigue area to tackle.

Senator Aird: In this specific case I note that the conclusion was that the most probable cause was the malfunction of a small mechanical device known as a pitch trim compensator. In your studies and as related to fatigue, did you come to any conclusion that would indicate that fatigue might have been a factor in this crash?

Mr. Thurston: No, sir, fatigue was not a factor in that crash.

Senator Thompson: You have travelled, looking at these two case histories and as I recall you have travelled a great deal with trains and with aircraft. There seems to me to be such an appalling incidence of accidents and it is suggested that accidents in cars are because of the construction of them. Have you thought of looking at this area or is there anyone who is looking at it from the point of view of manufacturing of cars?

Mr. Thurston: The answer is, sir, that at the moment we have investigated a number

of particular crashes in automobiles. Not long ago there was one on the Queensway which was brought back to the laboratory where it was proved that there was resonant vibration of the brake line and that it caused fatigue of the brake line. We investigated this accident and forwarded the findings on to Detroit and where else we thought we could influence the design of trucks. We do not have the capacity for systematically making investigation of all the possible fatigue failures of cars.

Senator Grosart: This whole discussion raises the very great problem of the degree to which our responses to science problems have been made on a purely ad hoc basis. The remark was made by Mr. Thurston that we do not have a systematic procedure for investigating these accidents. I believe this may be due to the fact that, as I understand, the entity within the Government which has the responsibility for motor safety is halfway between two departments at the moment. Is that correct? I was talking to someone the other day and he said he did not know which department he belonged to.

Mr. Thurston: I am not sure whether you are referring to automotive—

Senator Grosart: Yes.

Mr. Thurston: Automotive safety research is at the moment in a period of transition.

The Chairman: There would be some provincial responsibility there too.

Senator Grosart: But, we have an entity within the federal structure which has assumed responsibility here. I do not think they quite know under which roof they are at the moment.

Senator Aird: May I direct one more question? I am interested in your reply to two questions, the one that I asked relating to the fatigue factor in the airplane crash and you came back somewhat emphatically with a no. There was no fatigue factor and you replied to the question Senator Thompson asked relating to fatigue in cars. You said that you did not have—I have forgotten the exact words—systematic facilities. Would you reconcile those two answers?

Mr. Thurston: I am not sure what sort of reconciliation is most appropriate. There are I suppose of the order of 250,000 car crashes a year in this country. I am not sure of the actual number, and of course the idea that this small laboratory could investigate them

systematically is simply not possible. What I remarked about the car business generally was that we are not even sure we have, at the moment, a clearly defined status in car accident research. This, as I say, is evolving, but in relation to the aircraft crash of course my view that it was not fatigue was simply based on the specific investigation we did of that specific crash. I would not like to have to guarantee that no other aircraft of this kind could conceivably fail by fatigue in the future. Our investigation was confined to this particular set of circumstances.

Senator Thompson: Just to follow up on this, I think this is the merchandising of research findings. You mentioned that you sent the finding on the brake line or brake fluid or whatever broke down to Detroit in the hope that they might do something. I would hope that there would be a further follow-up for the safety of the public by Canadian research people and then into legislation. I do not know where that takes place, I do not suppose you would know how we could be assured the manufacturers would follow in respect to this.

Mr. Thurston: I am entirely vague about this.

The Chairman: It is somewhere between the Department of Industry and the Department of Health and Welfare.

Senator Grosart: While on the medical subject, I draw attention to page 107 which concerns ear defenders and ear phones. We have Senator Sullivan here who is probably one of the world authorities, if not the world authority. Perhaps we might take this up now in case he is busy later.

Senator Sullivan: Thank you very much, Senator Grosart. This is one incident where medicine greatly learns from electronics. Anyone who has any history of the last war and the problems we were confronted with would understand. It was my good fortune to be consultant to the air force in this particular field. I think the NRC, which belongs to a political administration society should be congratulated very much in this particular aspect. It is marketed now practically all over the world.

Senator Grosart: Here again, Mr. Chairman, we have the statement at page 108 as follows:

Initially there was difficulty in getting an industrial firm to produce the new design...

And the final comment is:

The initial project was started internally, accelerated by a request from industry and resulted in two products which are being manufactured by two separate Canadian industries.

This is one case, I imagine, where pure research paid off.

Senator Cameron: May I interrupt here? What was the time factor on this between the time the project was submitted and the time a satisfactory solution was found? Does anybody know?

Senator Sullivan: They have been working on this for quite a long time. I know it has been going on from the end of the Second World War. I remember when I was chairman of the auditory panel of the Defence Research Board dealing with otology, this was one of the problems being dealt with. We worked on it for a long time. What the exact period was, I couldn't say.

Dr. Schneider: Ten or 12 years.

Senator Cameron: When did it start?

Dr. Schneider: When it went into production? I don't think it was a very long period—about three years perhaps. I would like to add that the Acoustic Section made a very important contribution to the pulp and paper industry. Anyone who has been in a pulp and paper mill knows the noise made by the high-speed rolls.

The Chairman: Could you give us the names involved?

Dr. Schneider: Dr. Thiesen in the acoustics section. It turned out in this case that a very simple solution was possible only because these people knew a lot about acoustics. As you know they have to have holes in these rolls to press out the water, and these were very carefully drilled, all in a line across the roll, and at high speeds this generates a very intense single frequency. Simply by arranging a different pattern of the holes they could distribute this and it made a tremendous improvement in the noise level of these rolls.

Senator Sullivan: The men are wearing the ear defenders now. That was a big problem.

Senator Grosart: Then going on to No. 7 on page 32. You say "Some years ago the Director of the Division of Applied Chemistry was intrigued by the fact that crystals of barium sulphate suspended in benzene formed

spheres (agglomerated) when the suspension was shaken." As a result a process was developed by which industry has benefited. This deals with the spherical agglomeration of materials. Then on page 33 we read "It generally takes about 15 years for a new process to become established in industry largely because a new process has to compete with old, established processes in which industry has a considerable capital investment." I know this would not be applicable to the enzymes in the detergents, but is the lag really that long? Is Canadian Industry that inefficient? I ask this because industry is telling us in their ads in the business papers that they grab these things immediately, that they are always on the lookout for new products, and that they are geared up to put them into production. They are even ready to build in obsolescence to make sure that they are ready for the new thing when it comes along. Is 15 years an average estimate of the time it takes to get a new idea across to industry from NRC?

Dr. Cook: Mr. Chairman, this question raises a much broader issue which one could speak on for hours. A great deal has been said in the last 10 years or so to the effect that the time gap from research to application and practical use is getting much shorter these days than it used to be. We did a study some years ago looking at some 60 examples to try to find some evidence of this. It is true, of course, that due to the fact that many more things are developing today, the layman has the impression that things are coming much faster because there are more of them. But this is a different question from looking at an individual development to see how long it has taken from the initiation of research until its actual successful application in the economy. I think there is no evidence that this time gap is shortening at all. In fact if there is any evidence it is for the reverse and for various good reasons, I think. At any rate I have made it a personal crusade over the last five years to check with everyone who says the time gap is shortening and ask him for his evidence. I have received none. The bitter fact is that when one begins to think about the entire time span in any new development from research to actual application one has to think in terms of five, 10, 15 or 20 years. Now one can only make an observation on these things in general. One can always find examples that contradict that, but you can almost make the observation that the bigger

the economic impact is, the longer it has taken.

The Chairman: Take for instance the laser. Have you investigated some of these cases where the application followed very quickly in order to understand why it had been so fast in these cases?

Dr. Cook: I think the one outstanding thing that comes through is that acceleration of this process more than anything else results from a realization on somebody's part that they have a desperate need for a certain thing. That is the one thing that really moves the thing faster.

Senator Cameron: Let us take another area; let us take what has happened to the textile industry as the result of the development of plastics. Did this take 15 years from the time the new materials came into being until we had a complete revolution in the plastics industry?

Dr. Schneider: I think in this connection one can see very clearly what has happened. It is only in the past few years that synthetics have been used in things like carpets and clothing generally. Mention has been made of a big impact on the economy, but this would not apply to the laser. It simply has not made a big impact. It is a beautiful research tool but it is not responsible for a big impact which would compare with that of plastics and nylon.

Senator Sullivan: Mr. Chairman, I was pleased to hear what Dr. Cook said about the time gap because this also applies to drugs.

Senator Hays: In your study of this, what would you consider to be necessary to close this gap? Have you given much thought to this? Does the solution lie in the field of communications or does it involve the complacency of people who accept the products?

Dr. Cook: I think the only observation I can make is that I really don't see any way of shortening this gap in general. This seems to be the inherent, intrinsic nature of technology. Let me mention a case in point. Du Pont decided in 1928 to spend money on a research program to see if they could make a synthetic textile fibre.

It was approximately four years from the time they got together a research group and put that challenge to it until the first nylon thread was drawn out of a beaker in the laboratory. Another six years went by before

the first pair of nylon stockings went on sale. That was in approximately 1940. However, the real economic impact of nylon did not come until the mid-1950s and later.

Of course, nylon has more significance than just nylon. Once it had been discovered, people realized that synthetic textile fibres, which were better than natural fibres in some respects, were indeed possible. This in itself was a sort of radical concept. But once the first came then others started to look for other types of fibres.

Senator Hays: Was there consumer resistance as well?

Dr. Cook: No, I do not think so. I think it was the sheer technology of perfecting the fibre and perfecting the manufacturing methods. You see, nylon has completely different characteristics from cotton and wool in the weaving machines, and the people with the looms just could not cope with it at the beginning. I distinctly recall a friend of mine who was working at that time for CIL. He had to go around the textile companies in Canada during the war and try to teach them how to weave nylon cloth; how to alter their machines so that they would cope with it. It takes a long time to get something new like that introduced into the bulk manufacturing process.

The Chairman: Do you not think in some cases the kind of monopoly position of the firm or company has something to do with this? If a company can control the invention, then it can fit it into its production programs when it is most profitable to do so.

Senator Aird: I should like to make a supplementary comment on that, and give an example which I think relates a little bit to the volume of dollars and the volume of talent available. I understand that I.B.M. spent \$2 billion on research which produced the integrated circuit in a short period of time. It is true that this is a spin-off, but there you had the concentration of a tremendous amount of dollars and a tremendous amount of talent, and you came out with this result. I think you will have to shade your answer slightly. As you pointed out, the exceptions make the rule, but . . .

Dr. Cook: Mr. Chairman, you always have to shade these answers a little. I will try to speak in general terms. But, a question was raised as to the extent to which a single large

firm can delay or hold up the introduction of a whole new technology.

Originally, before I studied this in some depth, I had the feeling that this was probably true. I had read of a number of examples in which this was said to have happened. However, after making an extensive study of case histories I have come to a different conclusion.

There is not any question that from time to time large monopoly type industries have done their best to delay the introduction of new technology, and in some cases it is pretty clear that they have succeeded in doing it for a very short period of time, like a few years. But, I am now convinced—and I have examples to show it—that these efforts are usually pretty ineffective. They may try to delay, and may succeed, for a year or two, but someone somewhere—perhaps in some other country—who has nothing to lose, will bring it in within a relatively short time, so I am not really convinced that this is a major delay.

Senator Grosart: Dr. Cook, I take it then you would be inclined to modify the statement that appears at page 33:

It generally takes about 15 years for a new process to become established in industry largely because a new process has to compete with old, established processes in which industry has a considerable capital investment.

I think the misunderstanding may have arisen because of the word "process". This applies from process to process, whereas you are really talking about the time from initiation of research to application.

Dr. Cook: There is a point here, and that is that the introduction of a new process into an industry which is established always costs a great deal of money in both development and new investment. This new investment has to be balanced against the marginal improvements which the new process will bring. All of us have heard as children the teaching that if you build a better mousetrap the whole world will beat a path to your door. That is simply not true. The mousetrap has to be so much better than the old mousetrap that it justifies a huge investment in obsoleting what you already have. So, there are quantitative factors that apply here.

Senator Hays: But do not those go back to the consumer?

Senator Grosart: And go back to the textile or nylon people?

Senator Hays: In the matter of research or insecticides or herbicides, you come up with this problem in that case and the food and drugs directorate does also.

You have great masses of people saying you have to build up residues and all this sort of thing, and they won't use it.

I know that in the case of Manitoba No. 2 wheat, which we have known for many years will give an increased yield of eight to ten bushels, there is 30 per cent of the people still not growing it—the next door neighbours are not growing it—so it is in the field of communication and information and complacency . . .

Dr. Cook: Perhaps I could comment on that, too. There are many different kinds of technological innovation and, in certain cases like that, which impinge directly on the consumer, this is absolutely correct.

But for example, if you are buying a pound of aluminum, it is immaterial to the customer whether the electricity which is used in making the aluminum was rectified from alternating current to direct current by mechanical generators, or mercury arc rectifiers or silicon rectifiers.

The customer has no role to play at all. The company really has to decide how much this new type of technology is worth to them.

Senator Grosart: We are often told, Dr. Cook, that one of the reasons for the rapid industrial development in West Germany and Japan is that most of the factories were destroyed in those countries and they had to start afresh.

Senator Yuzyk: Is the gap there narrower say in countries such as the United Kingdom, where they are more effective, say, in industrial development than we have been—or is this quite general. You say it applies to the United States and Japan?

Dr. Cook: You raise another point, which I would like to make a statement about. These time gaps are just as great in the United States and the United Kingdom as they are here.

Senator Grosart: And Japan!

Dr. Cook: And Japan. I think we often tend to feel that the fields are greener far away and that in the larger and more technological nations like the United States and Britain and

Japan and West Germany these things are much more smoothly integrated and better handled. I assure you it is not true. They are merely operating on a larger scale.

Senator Cameron: What about the developing of transistors in Japan? I understand that was done in a relatively short time.

Dr. Cook: Mr. Chairman, this is an interesting point. The transistor was invented in the Bell laboratories in New Jersey. The whole discovery and invention took place around 1948, and I understand it was in response to a need. The American Telephone and Telegraph Company realized the need for an improvement in the vacuum tube, because they were finding that the depots of storage batteries on their long distance lines were getting to be too large a maintenance expense, and that they must consider some better kind of electronic valves which would not take that much power.

It was as a result of this that the programs began which led to the discovery of the transistor. It was the Bell laboratory development which initiated the initial technology. The Japanese have made a specialty of not being nationalistic about the importation of technology. They were perfectly happy, in order to build up their industry, to take all this initial discovery, invention and development technology from the United States and apply it quickly, so the apparent speed with which they have moved is really only a part of this 10- or 15-year period from research to application, of which I spoke.

There are many examples of this. Another one is Xerox. This is often quoted as an example. Before the Xerox company picked the Xerox process up at all, the process had been invented and totally developed and demonstrated on a bench at the Battelle Institute in Columbus. Really the development work had been done before Xerox ever began. The Xerox company (known then as Haloid) was near bankruptcy and could not have afforded to do it.

Senator Cameron: Then what the Sony people tell you when you go through their plant in Tokyo, or anywhere else, must be fiction, because they say this was started by two Japanese technicians in 1945 with the amount of \$500; that by 1947, which is before the Bell development which you mentioned came about, they were in business, but it was not until 1955 that they really captured the mar-

ket. This is the story they tell when you go through the plant.

Dr. Cook: I am surprised at that. The whole world knows where the transistor was invented.

Senator Cameron: I was just curious, because this story impressed me very much.

The Chairman: It shows the kind of situation you get into when visiting plants.

Senator Grosart: I do not know whether this relates to Senator Cameron's visit to Japan, but a friend of mine who came back from there recently said that the Japanese claimed to have invented everything, and added that some people got the impression they were now claiming to have invented sex, which anybody who has been to Tokyo recently will understand!

The Chairman: At least they might have invented a new approach!

Senator Grosart: I knew I was getting on a subject which had your interest, Mr. Chairman!

I suggest that we might now move to "Physical Standards", where, of course, the NRC has an outstanding international reputation. On page 36 we read:

Canada's outstanding contribution is recognized by all major national standards laboratories in virtually every standards field.

Then later we see:

NRC scientists have been invested with international responsibilities of the highest order.

My understanding is that the major responsibility in this field was a good many years ago given to the NRC. I wonder if Dr. Schneider could tell us the relationship between NRC, the Canadian Standards Association, which gets a grant of \$50,000 a year from the Government, and the projected new National Standards Council that is to be set up. I understand it is in the process of being set up under the Department of Industry. What will be the relationship between NRC and these two other groups?

Dr. Schneider: I do not know whether I can answer this completely. First of all, as far as primary standards are concerned, this is a statutory responsibility that the National Research Council has to maintain in respect of all physical standards in Canada. That is a

primary reference. Then there are certain references which are calibrated against these primaries. There is a standards organization in the Department of Trade and Commerce to check commercial products. The Canadian Standards Association is not a governmental body. It is a private body organized by manufacturing industry and they set up standards which are then adhered to by manufacturers and which permits them to compete in export trade and so on.

Now, the new standards council, as I understand it has not been completely worked out. We have not seen the legislation that is proposed. I understand somehow there is to be a marriage between this standards council which is supposed to concern itself with all consumer products, and the Canadian Standards Association. I do not know how this is to be done.

Senator Grosart: Is the National Research Council role limited to physical measurement standards then?

Dr. Schneider: We do not, for example, do standardization tests on consumer products, and so on, but rather the standards themselves.

Senator Grosart: That is the official, national standards?

Dr. Schneider: That is right. For example, we will calibrate against these primary standards. Secondary standards would be the thermometers, or length standards, for example tapes, but we do not get into the consumer products.

Senator Grosart: In the endorsement of existing standards, say, in defence production, what is the method of establishing your endorsement? Is it a document or seal?

Dr. Schneider: Perhaps Dr. Tupper would like to answer that question.

Dr. Tupper: Mr. Chairman, I think in this discussion we have got to distinguish between standards and specifications. CSA, although it has in its name the word "standards" has over the long period largely been a specification generating body. Specification generating bodies are highly necessary and desirable, if there are to be accepted specifications for certain things, as there have been. CSA has had specifications for reinforcing-bars for making concrete, et cetera. These can be quoted by architects and engineers, and they can then be policed in many ways, which require tests

on the product to see whether the product indeed does match the specifications.

We get into this in a very minor way in testing certain things against our standards, and normally we would provide, you might say, a short laboratory report, which might even take the form of a letter, in which we would record the measurements that we had made on the device in our laboratory and would comment on them versus the specification, if there were one. So we get into this in certain cases where the products would have to meet, say, a military specification in a foreign country where a manufacturer in Canada is trying to sell parts or components in a foreign country and has to have the test made to show that the characteristics are such that it will meet the specifications.

Generally speaking, test work is not an NRC mission. We try so far as possible to avoid getting into test work, particularly if it can be picked up by commercial laboratories, organizations that you might say are in the business of doing analytical or measuring work to commercial standards. We would, of course, calibrate their equipment. This would be a reasonable role for us, but test work we get into only when it is in the national interest and no one else in Canada is capable of doing it.

Senator Grosart: Would you be concerned, for example, with Canadian Government specifications coming out of, for instance, a specifications division? I am thinking particularly again of the automotive field. I believe there is a specifications division which sets up the standards or specifications that suppliers of vehicles to the federal Government are required to meet. Do you work on that?

Dr. Tupper: In general, the answer is: No, because the responsibility for producing the specification is not ours. We would, of course, gladly assist the department or the agency that carries that responsibility, if they came to us for advice or help.

Senator Cameron: I wonder what your plans are regarding the adjournment, Mr. Chairman.

The Chairman: I was intending to propose that we should perhaps continue for another five minutes and adjourn at a quarter to one.

Senator Robichaud: Mr. Chairman, may I place a general question to Dr. Schneider? I would like to know what is the policy of NRC in order to follow up projects by Govern-

ment departments or industry when such projects are implementing findings by the council.

What leads me to ask such a question is that in your case history of specific projects you mention the wave absorption breakwater which was developed, a hollow concrete breakwater with openings on the seaward side, in order to absorb the energy from the wave or eliminate the spill-over on the wharf or breakwater.

At the bottom of page 97 you mention:

On the basis of this report Public Works decided to proceed with the construction of a wave absorption breakwater at Baie Comeau. The new harbour facility was inaugurated in July 1963 and the breakwater has functioned successfully since.

On the following page you mention:

Another breakwater based on the same principle was subsequently constructed at Saulnierville, Nova Scotia.

Here you make no comment as to how successful it was.

The Chairman: Do you have the answer?

Senator Robichaud: Well, I would say that in the summer of 1967 I spent an hour on that breakwater at Saulnierville, and I had to leave my car ashore because it was moving so much, and part of it had already been carried away by the waves. That is why I was asking the question.

Is there a follow-up of such construction, as there is an urgent need for the type of breakwater that will eliminate the spill-over? Is there any reason why the Department of Public Works did not proceed with further construction?

Senator Grosart: Before Dr. Schneider answers, Mr. Chairman, to keep the record straight, may I suggest that we are on 23, on page 96?

Dr. Schneider: First of all, I would like to say that in the case of Baie Comeau there were extensive tests done after construction, and our division of building research was involved in this. I do not know the story on the Saulnierville one. I wonder if we could ask Dr. MacPhail to give us more information on this?

Dr. MacPhail: Mr. Chairman and gentlemen, I should say that, when one makes a development of this kind, which involves a

great deal of money, scientific people, unlike the image they are supposed to have, are extraordinarily conservative; and in this case we tried to persuade the Department of Public Works...

The Chairman: That should please Senator Grosart.

Senator Grosart: I am a *Progressive Conservative*!

Dr. MacPhail: We tried to persuade the Department of Public Works not to build the one at Baie Comeau until they had further experience.

The reason for this is fundamental. We had quite clear laboratory and scientific information as to how this would work in the hydrodynamic sense. There is a very serious worry in concrete structures subjected to alternating loads because of the fact that concrete opens and exposes the reinforcing bars, which are then open to the sea and they then corrode and you may lose the structure. It was on this ground that the division of building research and division of mechanical engineering, who had done the hydro dynamic work tried to persuade them to go more slowly. There are occasions that you gentlemen would be much better aware of than we would be, where it is really necessary for these people to proceed; and they proceeded and we, in fact, have photographic records in great detail to show both the wave action with the business, which is, in fact, a success. It does not allow the waves to break over the top whereas, in fact, the waves break completely over the top of the solid Baie Comeau breakwater at the same harbour. In other words, the hydro dynamic characteristics work as they are supposed to and there is no doubt about this. The structural side was a subject of considerable investigation, also between the division of building research and ourselves and the installation of various instruments and records and this, in fact, has worked all right. The third issue, which is an issue again of collaboration between the two divisions, is the form of the substructure. That is to say the rubble, the gravel or crushed rock underneath this thing. This type of breakwater has the advantage which a solid breakwater has not. It induces a shoreward current at the bottom which carries in substance instead of washing it away. There are two normal kinds of failures of a breakwater. One of these is a failure in which it

falls into the sea because the structure underneath has been carried away and the other one is the one which is the lifting off of rock which may be as heavy as 30 or 40 tons. These are cut stones which, in spite of their great weight, may be lifted due to the high pressures of breaking waves. The Saulnierville breakwater has got into trouble which we have not followed. The Baie Comeau was one which we left and we left it with the advice that this type of thing should be built with prestressed concrete so that the cracks would not open in such a way as to corrode the structure. The subsequent operation which has been carried on there and in fact other places around the world by a patent licence arrangement, we have not followed, but there is I may say in the civil and mechanical engineering business plenty of capacity for failure.

Senator Robichaud: I have a similar question on another project.

The Chairman: Could you postpone it? The committee is adjourned until 3 o'clock this afternoon.

The committee adjourned.

AFTERNOON SITTING

(Second and Final session)

Upon resuming at 3 p.m.

The Chairman: Senator Grosart.

Senator Grosart: Mr. Chairman, according to my accounting we have covered 15 and touched upon several others of the 35 case histories that have been mentioned. I thought in view of my earlier remarks on what I regard as the importance of case history No. 33 on page 127 we might move to that now, with your permission.

I think I said that if I had to make the case for the necessity for a Minister of Science Policy or a reasonable equivalent thereof I would cite nothing more than this particular case. Now because this very voluminous report may get buried in our proceedings I would like to run over quickly the sequence of events of the frustration of the NRC and apparently others in this very important field of radiation biology. This is a question that has agitated the Canadian public, less today perhaps than 10 years ago, but the evidence in our committee hearings indicates that there

is still considerable concern among Canadians about protection being provided by the science policy of Canada, whatever that may mean, for Canadians in the matter of possible biological effects of radiation biology.

As I understand it the sequence from this report is as follows: In 1957 Mr. H. B. Newcombe of AECL documented the case for an increase in Canada's research in radiation biology. The AECL took a firm stand against an increase in staff at Chalk River. Then three years later, in 1960, Mr. Newcombe decided to contact the Genetics Society which is a Committee on Radiation Biology. He had in this the support of AECL and NRC. A symposium was organized and recommended that NRC form an associate committee and NRC agreed. That committee recommended support for radiation biology research in universities and the formation of the Central Research Centre.

In the next year the NRC Standing Committee on Biology recommended against A and B which I take to be the recommendations of their own associate committee. They advised, however, that they were in favour of some form of university support and the turning over of this to two or three key scientists. The report says that A proved ineffective and B was never acted upon. I am referring now to page 130.

In 1961 there was a House of Commons committee and it recommended strongly that there be something done about the situation. The Standing Committee on Biology of NRC in August recommended that there be an NRC budget and a director appointed. Then Mr. Steacie was asked to get Treasury Board approval. He discussed it with AECL, the Defence Research Board, and the Department of National Health and Welfare. The cabinet in 1962 gave approval that there was to be a radiation biology division of the National Research Council conditional upon the Treasury Board finding the money, the staff and funds. That is on page 131.

Then we learn that nothing was done for a year-and-a-half. The NRC then provided a budget and a general decision seems to have been that they should move to Chalk River in spite of the previous decision of AECL. AECL agreed but when they got up there they found there was no housing accommodation.

So, Public Works got into the act and decided they would fund the laboratory, and the project moved back to Ottawa. In 1965 nothing seems to have been done. In 1966 the

construction of the lab. began. In 1968 the staff moved in.

In July, 1968 the NRC Division of Radiation Biology was joined with two-thirds of the Division of Biosciences to form the Division of Biology. This was done on the recommendation of a Biology Review Committee.

Then you say:

The final phase in the grouping and realignment came in October, 1968 with a decision to have the eight-man radio biology team or DRB join the thirty-man NRC group and work in the new NRC laboratory.

I suggest the fact that it took 10 years of what is described here as "dialogue"—and it is much more than dialogue—of frustrations, attempts at co-ordination, requests for agreement on a policy, is a situation that, in a matter so important as this, should simply not be allowed to happen again.

I commend the NRC for giving us this case history, even to the extent there is some self-criticism of the NRC in this, and I think we should compliment Dr. Schneider and his associates on being as frank as they have been in this particular case.

I have suggested this seems to me to indicate that somehow in Canada we have to get something more than the statements we have over and over again that, "There is all sorts of co-ordination in these matters. Some of our fellows sit on somebody else's committee and we all meet regularly and we co-ordinate these things."

Surely, this is exactly where there must be control. There must be a mechanism for political decision so that NRC, AECL, anybody concerned, can say, "All right, we now have a cabinet decision." In this case it came from a House of Commons hearing; some cabinet approval came six years after this started; the responsibility was not given fully to NRC until 1966; and it was not until 1968 that the staff moved in. What is your comment on that?

Dr. Schneider: I think you have put a lot of it very well. Certainly, one of the reasons we included this case was because it did involve particularly difficult and drawn-out decision-making. This is not to imply that this is a normal sort of thing, but these circumstances will arise.

Here there were quite a number of circumstances, and I should also perhaps add that when NRC established the associate commit-

tee they addressed themselves to the problem not only of providing, let us say, a central laboratory which would provide back-up information on this to the Government, but also developing radiation biology generally in Canada, because it was underdeveloped and obviously was going to be rather important in the future.

The associate committee struggled with this and also attempted to get some universities interested—I would say, only with limited success. There may be a number of reasons for this.

I think if you talk to biologists quite a lot of them will tell you, "What is different in radiation biology than in any other kind of basic biology? You are simply using radiation as a tool." You might want to study genetic effects and mutations, and geneticists might be using something else to induce mutations. On the basic side they did not feel that this was a separate discipline, so there are people doing work related to radiation biology in universities, but what the associate committee had in mind was a concentration somewhere where the work would be looked at in more depth.

We still know so very little about the basic or, shall I say, chemical effects of radiation on living systems. This is quite apart from worrying about methods of protection, health, and so on.

Ultimately, as I say, the recommendation of this associate committee was that there should be a central laboratory established somewhere. The reason why it was recommended in NRC was because AECL, although they were working daily with radiation and had to worry about it from the health hazard point of view, did not feel this was their primary concern. However, they did have some people knowledgeable in this field.

The Chairman: So, Atomic Energy was involved in this?

Dr. Schneider: These are the atomic energy laboratories.

The Chairman: But they had a special responsibility in that field too.

Dr. Schneider: This is for inspection and control. You see, the problem in the Chalk River laboratory is really protection of personnel, and these two are involved.

In the meantime this is also a matter that has to be of concern to the Department of National Health and Welfare. Of course, the

Defence Research Board, since their mission is defence, also has to be concerned about this.

So, you have those four agencies plus what interest there was in the universities, and this was the reason why the associate committee was set up, to see if we could all get together and decide what needed to be done. In fact, the associate committee did make recommendations according to the way they felt the whole area had to be developed, and one recommendation was that in addition to supplementing some of the work of the universities there also needed to be one central laboratory which would go into this in depth, and this was to be the National Research Council. Admittedly, there were delays. I do not want to appear to place fault in one direction or another, but we did go through a period when budgets were tight, and a building had to be built. Dr. Butler, who was named the director, did recruit some staff, and had borrowed some space—some at Chalk River and some at the laboratories of the National Research Council—and got started. But, he could not get started on a sufficient scale until more space was available.

As has been reported here, this building has been completed, and was occupied last summer. In the meantime by mutual discussion and consultation with DRB the decision was made that since they have a relatively small group—it was not a viable research group—and it would be to everyone's mutual benefit if this group could join Dr. Butler's laboratory. They would still remain as DRB employees. They would still have some expertise for their own purposes, but they would do their work in Dr. Butler's laboratory.

Since that time there has arisen the question of precisely how far Atomic Energy of Canada Limited should be going into this field. They have developed some very excellent techniques for detection of contamination, and also for ecological studies, in the surrounding neighbourhood, and so on, and, of course, they do have a responsibility for the health of their personnel. But, I think it is the feeling of the staff there that they would not have the resources to go into the more basic studies, and it was primarily a result of these most recent discussions that the Science Council, at the request of Atomic Energy of Canada Limited, was asked to make a study of this area as it is at the present time—whether we are doing enough in this area, whether more should be done, or whether it might be developed in other ways.

Finally, I might point out that in so far as the Department of National Health and Welfare is concerned, it is more particularly concerned with the monitoring side, and not so much with the longer range basic research in order to get a better understanding of how radiation damages living systems, and what can be done about it, and so on.

That is where the matter stands now, except that I would add that this was not so much a problem of co-ordination as it was a problem of central decision-making.

There is a very close co-ordination. Dr. G. C. Butler, who is the director of this laboratory now, was at one time on the staff at Atomic Energy of Canada Limited; he knows all the personnel there and still maintains close contacts there. I have already mentioned that the DRB group is transferring to his laboratory. He also maintains very close personal contact with personnel in the Radiation Protection Division of the Department of Health and Welfare. Each year he makes a survey of university research in radiation biology, and these people have contacts. Every two years he assists in organizing a symposium attended by all Canadian researchers in radiation biology. Finally, there is the NRC Associate Committee on Radiation Biology, formed in 1961.

Therefore, on the technical and scientific side I do not think there is so much of a problem on the co-ordination of work. There was something of a problem in the centralized decision-making and perhaps, if you like, the allocation of responsibility, precisely where this was to be.

Senator Grosart: That is exactly my point. Let us assume Mr. Newcombe was right in the apparently urgent reasons he put forward for action, which are on page 128, where he says:

Canadian diplomats in the United Nations were calling for more efforts in radiobiology while nothing was being done at home.

Yet from 1967 nothing was done that could have brought about some kind of political decision before 1962, what mechanism could you suggest now? There is this almost tortuous path towards the political decision-making in the science area, which is something that we in this committee are concerned with.

Dr. Schneider: I think we also have to distinguish here two aspects of the problem. Perhaps the one in most people's minds at

one time was rather more a monitoring function than a research function. I think we should distinguish the research function and the monitoring function. For example, at the municipal level I understand the City of Hamilton hired someone to monitor radiation for the city. At that time there was a great deal of worry and concern about the level of radiation.

Senator Grosart: We used to get reports in the newspapers periodically about the level of radiation in milk and so on.

Dr. Schneider: That is right.

Senator Grosart: My point is that there seemed to be no political decision made. What I am asking is: can you think of any way this process could have been speeded up between 1957 and 1962 when the Cabinet finally said, "We give approval"? I do not care that they gave approval to, except that it was some kind of action in this field. In the meantime, there is no evidence of any action other than co-ordination, talk and so on. It seems to me that a calamity could have occurred in this area.

Dr. Schneider: If we had had a nuclear war at that time we would have had to mobilize a great deal more strength in this area. It is a little difficult to say. At that time, of course, we did not have all the organizations or organizational structures that we now have. I think it would be a little easier today to make a proposal and have this represented through various bodies, through the Science Council, Science Secretariat, ministries and so on, not only to get a decision but also to allocate resources.

It is one thing to say it is a good thing, we should do it, but it is another thing to have the resources available. The other thing I think we have to distinguish is the matter of making decisions about responsibilities. As I say, there is a research function here and there is a monitoring function. Now, you see the responsibility that NRC has in fact taken on is not a monitoring function, it is purely a research function and we are depending on other agencies, such as the Department of National Health and Welfare and to some extent AECL and so on for the monitoring function.

Senator Grosart: Does anybody have the total responsibility to the Canadian public or the Canadian Government for the monitoring of what is generally called radiation nuclear fallout?

Dr. Schneider: I am afraid I cannot give you a complete answer on this because I do not know what statutory responsibility the Department of Health and Welfare have. They do have a radiation protection division which is concerned with the level of radiation.

Senator Grosart: We also have an Atomic Energy Control Board which is controlled by practically the same people and may be one of those creating the hazards, that is the Atomic Energy of Canada Limited.

Dr. Schneider: The whole role of the Atomic Energy Control Board was, as initially set up, to worry about the controls of, let us say, sales of uranium and so on.

The Chairman: The other functions as well.

Dr. Schneider: This is a function that has been growing more recently when reactors are being built to worry about the safety precautions on reactors and the question of licensing.

The Chairman: Instead of worrying about research problems in that field, which is of their immediate responsibility, we are told that they help the National Research Council up to and in an amount of about \$2.5 million in sponsoring research in universities and pure physics.

Dr. Schneider: Nuclear physics, that is correct.

Dr. Tupper: Mr. Chairman, I would like to make one observation there. I think we must distinguish between the monitoring of what you might call local levels and the monitoring of high levels. Local levels, in so far as the federal Government is concerned, would appear to be, and I say this without having looked at the legislation, the responsibility of the Department of National Health and Welfare. Although this may be getting a little clouded, if radioactive material were in water so it became a particular form of water pollution, responsibility might fall into the Department of Energy, Mines and Resources—

The Chairman: Or the Department of Fisheries.

Senator Grosart: Or the 228 organizations we have been told have some function in the field of water pollution.

Dr. Tupper: In the high level region we have the Emergency Measures Organization

in the Department of National Defence. I believe recently EMO has been put under the Minister of National Defence.

Presumably there was some beneficial change here in so far as fragmentation of responsibility is concerned.

Senator Grosart: Is there anybody we can courtmartial or hang if this thing goes wrong?

The Chairman: Let us come back to this specific case. This case is now practically solved, but I think just to use it as a kind of an illustration, were not the delays in this case caused by, let us say, disagreement between or among the public servants or because of the lack of action by the Cabinet?

Dr. Tupper: Lack of urgency I think. There was not in either the public mind, the scientist's mind or the Members of Parliament mind a real sense of urgency in getting on with it. I think this is probably more nearly the reason for the delay.

The Chairman: There was no great disagreement as to where it should go within our research agencies?

Dr. Schneider: There was complete agreement on this, but as Dr. Tupper says, at that time it was not regarded as a matter of great urgency. The funds had to be found within regular budgets and so naturally it could not get off the ground with a bang and had to be built up more slowly.

Senator Grosart: In other words, nobody took Mr. Newcombe seriously? He thought it was a matter of great urgency, obviously.

Dr. Schneider: This is where we started further back. Six years later I do not know how urgent he would regard it.

Senator Grosart: I would not blame Mr. Newcombe if he lost interest.

Dr. Cook: Mr. Chairman, perhaps I ought to say a word here. In the years immediately preceding 1957 I was at Chalk River and had long discussions with Mr. Newcombe about this. What he was very concerned about was the relatively low levels of irradiation which do not have any immediate effect on the people being irradiated but he was most concerned about the genetic effects which do in fact ensue over the succeeding generations. He was particularly concerned that we were moving into a period when it would be much more difficult, if not impossible, to check these effects, because once the world becomes

blanketed with higher levels of fission products than ever before, you find your sort of zero value is gone and you can never more refer back. I think Newcombe was very very concerned about this, and I doubt if this concern has diminished one iota; but where it runs into difficulty is that, as humans, we are not notorious for being exceedingly concerned with things where the problem is going to be ten years off, let alone a couple of generations away.

Senator Grosart: That is what we leave to our Government.

Dr. Cook: That is probably why this thing wandered, not because of its not being urgent but because it is not the sort of immediate tomorrow type of urgency. I think that is why the discussion wandered.

Senator Grosart: Senator Thompson asked some very interesting questions on this subject, in connection with protection of nuclear materials in transport and so on. I wonder if you have any comment to make.

Senator Thompson: It was in connection with road transportation, in talking about the atomic reactor study, and apparently that is not covered even today, in regard to the dangers of radiation when you are transporting dangerous material by road. It is covered by sea or air, I understand. From the previous hearings we have had, there seem to be gaps, lack of co-ordination, in this whole area of supervision by Government.

Dr. Cook: If I may, Mr. Chairman, I would re-emphasize the fact that there is a tremendous difference between the problems where you may get a high level of radiation for a short time, and that is what is involved in transport, the thing falling off a truck and breaking, and a number of people who happen to be around might get a dosage which might put them in hospital the next day—this is quite a different kind of problem from several points of view, from this problem of relatively low levels of radiation but nevertheless enough to do permanent genetic damage to future generations.

Senator Thompson: I was concerned also in connection with water pollution by radiation. Again, when the Atomic Energy Board was before us, they said they do a kind of sampling in some lakes in Saskatchewan. However, there is an outflow from some of these lakes. I am thinking of Elliot Lake where there can be an outflow. It appeared to me

that the approaches taken with respect to the discharge of radiation materials there were completely unsatisfactory. Just whose responsibility was it to keep on top of this? The flow gets into the major lakes.

The Chairman: I think we are quite sure, in spite of present confusion, that this does not lie in the responsibility of NRC.

Dr. Schneider: Here is a good topic, you see, if you are talking about science policy and priorities: to say, what priority are you going to give this, or how much effort are we to put into it. All of these things can be done. You can monitor all the lakes and land and do a lot of research and put a great deal of effort into this, but it has to be done along side all the other things we want to do. How do you decide? If we thought there was a nuclear war imminent, I am sure we would drop everything else and immediately go after this. But once that initial scare had sort of subsided, obviously, then, this would take on a lower priority.

Senator Grosart: But, from Dr. Cook's comment, the problem would seem to be that the lower levels may not necessarily be the lower priorities. If it is possible that these low levels are going to create genetic disturbances and perhaps malformities in future generations, surely we should be saying, "Let us look after the low level ones anyway."

Dr. Schneider: This was certainly a concern at the time when there was a lot of atmospheric testing of "dirty" nuclear bombs, because then you had these kinds of levels that one might want to worry about over the long term.

Senator Grosart: What happens if it has already been started and is already going on? Do we know? Let us say the starting date was 1957. In these ten years of relative inaction, do we know if genetic problems have already been created for future Canadians, or do we care? Or, who cares, I should say?

Dr. Schneider: Yes, there are people who worry about this. And the general level of background radiation that everybody is exposed to—and there is not much we can do about it because it comes from the sun and outer space and so on—is a thing that the human species has adapted to and learned to live with. Whether that causes some mutations, we do not know, but the concern is really that once you get substantially above

this background of radiation, then is it dangerous?

Senator Grosart: I move now to No. 9, Mr. Chairman, the ethylene oxide production process. The comment here is that it was a technical success, but an innovational failure. That is understandable. Looking at page 40, apparently the project was reduced to a minor level owing to a recommendation of an NRC Review Committee, which said that the resources of that division could be applied more profitably to other projects.

Could you tell us something about the work of the NRC Review Committee? What is it? Is this an over-all committee reviewing all projects?

Dr. Schneider: No. This has evolved over the years. At the particular time when this project was going on this was a committee of council. Since that time a number of the divisions have what we call an advisory committee. These advisory committees meet several times a year to discuss the programs with the Director of the division, and they visit the laboratories. These committees are composed of some Council members together with experts from outside, from industry or universities as may be appropriate. Quite a number of the divisions have advisory committees of this kind.

Periodically, that is, every three years, an ad hoc review committee is set up comprised of a group of specialists who know the area very well and who review the programs in a division. The most recent one was referred to in one of the cases here, the Review Committee on Biology. They had also considered the question of radiation biology, and this will be done periodically for those divisions that do not have a standing advisory committee.

Senator Grosart: Over the years you have developed as of this moment about a thousand projects. Are you satisfied that these are the thousand most important projects that should be the subject of what is in effect the operational research agency of the Canadian Government?

Dr. Schneider: I think that is a very big question.

Senator Grosart: But very important.

Dr. Schneider: Let me say this: I think in any human endeavour there is always room for improvement. I would not like to suggest that this is exactly the best selection of projects we could possibly have and we are stead-

ily going to be reviewing these projects and deciding whether some of them should get higher priority and some lower priority and so on. I think one of the constraints you have is, for example, the kind of people you have, their particular capacities and potential and so on and then of course there is the question of resources in terms of money. It may be that there is a much bigger or more important project that should be done, but with the resources we have we might not be able to do it. But this is the kind of thing we should look at and decide. I personally feel that the research council as such should be flexible and not too big, and I for one would not like to see it grow indefinitely. I think it can be much more effective if it were limited to an appropriate size and doing the most important work it can in the most important areas where work needs doing. First of all if NRC is the right agency to do certain work we should not keep it to ourselves if it can go anywhere else, and the sooner we get it to industry, for example, the better. Those projects in which we are doing some exploratory research, if they do not look as if they are going to go some where, then they should be dropped. At any one time you have certain resources in skills and in money, and then you have to look at whether or not you are working on the most important projects at the particular time. I think perhaps I would like to see, since we are going through this examination very seriously, the Council thinking bigger in terms of major projects with not so many smaller projects. Here again this has to be assessed against the background of, first of all, the importance of the project and, secondly, whether we can mount these resources. Rather than simply taking on a lot of ad hoc problems brought to us, and at times we have to do a good deal of this because we are expected to do so and it is part of our responsibility, but at the same time some very important problems that are and will be facing the country are going to take major resources, and very often these require an inter-disciplinary group of researchers, not just engineers or physicists, and perhaps we ought to set our sights higher as we identify which of these projects should be mounted.

In other words what I am trying to say or the question I am asking is whether we could be more effective by having fewer projects, but much larger projects, rather than being too diffuse.

Senator Aird: That is a most interesting thing that you said at the last. You said you were asking. Of whom are you asking that question?

Dr. Schneider: First of all we are going to ask ourselves this question and then we have to decide what are the important projects and when we decide that we have to go to a higher forum and discuss these as proposals. If there is no agreement elsewhere, or if there are other more important things coming up elsewhere, naturally these will not go ahead.

Senator Aird: It is your present intention to ask this question?

Dr. Schneider: Right.

The Chairman: Perhaps it is unfair to ask you this question, but how would you visualize, when undertaking this review, the place of the National Research Council not only within the federal research function but also within the more general Canadian scientific and research community? As you know, and I am sure you know much more than I do, the National Research Council started as more or less the centre of the government effort in research. Then there was a gradual evolution and other federal agencies were created. As you see your future evolution do you think you should become a kind of residual establishment leaving projects, for example, in agriculture, to another agency?

Dr. Schneider: In that regard let me say that I think the National Research Council could play a very important role. I think we all agree that science is not an end in itself, except in a certain sense, but I think from the Government's point of view science is a means to an end. I think we also recognize that there is quite a lot of research being done in universities now and in industry and in other government laboratories. Furthermore since resources and funds are going to be limited we want to make sure we get the most use out of the resources we have, and I think this requires a certain co-ordination and interaction in the industrial, government and university sectors. I think NRC could play a very important role both in co-ordinating and developing this interaction and certainly I think we are playing, and I suspect we will be more so in future, an important role in the evolving of co-operative programs in these three sectors. I think beyond this that there are other laboratories, government laboratories, that have functions in specific fields.

These areas are taken care of. I don't worry about them, but there will always be gaps in areas where something doesn't fit completely into the mission of any one laboratory, and I think NRC has a role to play in making sure that gaps don't exist where there are any such research areas to be gone into which don't fit into the mission of any specific agency. In that sense we will, if you like, take a responsibility over the whole spectrum of both pure and applied science. This will not be with the idea of invading any other areas or taking on any other missions but rather to play this "filling-in" and co-ordinating role, which I think the council is doing to a very large extent and also, as new opportunities and the possibilities for new technology, and so on arise where NRC could do something about it and at least point these out. So in this sense I think the council's laboratories don't need to grow too large, but I think that interaction with the universities and the industrial sector needs to grow. I think if a research program has been started we should not of necessity hang on to it forever. It should either be transferred to industry or perhaps to some other government department. But in that sense I think NRC could best meet its role by being flexible and responsive rather than trying to build up a big empire.

The Chairman: But in a specific instance, how do you divide the work in the field of agricultural research? We had the Department of Agriculture before us, and at some stage—I do not recall exactly, but there was, it seemed to me—and it is vague at the moment, because I do not have the evidence here—that the division of effort between the Department of Agriculture and NRC looked a little phoney. I do not remember exactly what it was, but when it was a matter, for instance, of food research it was Agriculture, and when it was not food it was NRC, or something like that.

Dr. Schneider: Actually, you have a couple of cases here you could raise this question on—the rapeseed development, which was a joint effort between Canada Department of Agriculture and NRC, and the food storage problems, and so on.

I should point out here that we have a statutory responsibility in our act, if I remember the words correctly, "to improve the conditions in agriculture." Actually, we recognize that the Canada Department of Agriculture has a mission in this field, and

there is certainly absolutely no intention of invading this field. Any work that has been done in this has been done by mutual consultation with the Department of Agriculture and, in some cases, where they have asked us to do this.

Certainly, I would say that the relations between the Department of Agriculture and NRC over the years have been very good, and I think a lot of credit for this goes to Dr. W. H. Cook, whom I see here, who used to be Director of the Division of Biosciences at NRC. They have always enjoyed the best relations and they have had very close co-operation and co-operative programs.

Senator Cameron: You referred, Dr. Schneider, to some thousand projects which are under way, or as being the most important things you can do at the present time. I am wondering if anything has been done to establish a sort of overall inventory of all the things that should be done, and a breakdown as to who might be responsible. That is one thing, to have an overall picture of what our responsibility is going to be over the next five years.

Dr. Schneider: Who should make this inventory? Who should draw up this list?

Senator Cameron: That is what I am trying to get at.

Senator Grosart: This is what the senator is asking you.

Senator Cameron: Has anybody done it? If they have not done it, then who should do it—prepare this overall inventory of programs for the next five years of all the things we should be working at? Obviously, there will be many things we cannot touch, but then you would go through that list with your advisers and say, "This is what we can do with our resources of manpower and dollars", and so on. Out of that we might get a rationale of how to go at this thing from a national policy standpoint.

Senator Thompson: Mr. Chairman,—

Senator Cameron: I wish to go on with this, but you ask your question.

Senator Thompson: My supplementary is on these thousand projects. I notice the flexibility by which you have certain individuals having informal relations. They present an idea and get excited about it, and you say, "We will look at it." I wonder whether before you look at it you might say, "Let us find out

from your peers or your associates whether this is really the priority we should follow up on." You have such a gammit. This sealed double glazing, is this the most important thing for the building industry that you should follow up? Did you ask the industry about it, or just take the project approach?

Dr. Schneider: First of all, I think I should make it clear that I do not know where the number of some 1,000 projects came from.

Senator Grosart: It came from me. I counted up the projects in Part VI, and came up with the figure of 934, and I assume they are all here.

The Chairman: They have become 1,000!

Dr. Schneider: I think perhaps there is a lot of confusion between projects and programs. Projects can be a one-day affair or a much longer affair. But I think you have raised a very important question, and it really raises the question of priorities and how projects can be supported, and so on.

First of all, on a broad basis we really approach this in two ways and, as has been pointed out in this report, a lot of these projects come from the outside. In other words, they are problems people come to us with concerning which they want help. For instance, you mentioned the building industry. Regarding the Division of Building Research, this has been their primary function, to provide the back-up research and development for the building industry. If they come with a problem like this and it is getting into millions of dollars, with a lot of large glazed areas breaking which have to be replaced, this becomes serious.

This is one way you start your inventory, with the problems people bring to you, the problems they have and how important they are. The other is the ideas which come up within the laboratory. These, of course, have to be assessed separately on their merits. This becomes a bit more difficult, because of the discussion we had earlier this morning, when you talked about cost benefit and payoff, some might be quite long range. It sounds like a wonderful idea, "If only this could be pulled off it would be terrific." You are not going to know unless you try it. This is something you have to weigh as against the other things you have to do, visualize the idea and the project. You also, first of all, have to know how many resources it would take, and whether you have sufficient resources to con-

sider undertaking it. And, if you have, whether you have really good people, because that is the most important thing when you start a way-out idea. All these things have to be weighed and, ultimately, we make an allocation to each division based on the way they rate their priorities. Beyond that, it is up to the director to live within his budget, and he has a certain flexibility in the allocating of these resources within his division. But let me assure you this is not a simple matter, and we are trying to develop other ways and means of looking at this and trying to assess this. This would be one of Dr. Cook's jobs, in trying to assess some of these projects.

Senator Thompson: You referred to one director, I think in the Atlantic provinces, as having a free enterprise research approach. Is that the term you used? The impression I got from reading that, which was some time ago, was that he could really choose whatever he wanted from what was coming in to him rather than getting direction from Ottawa about what research he should undertake.

Dr. Schneider: This is not quite fair. This is particularly important where you have a regional laboratory. It is important that the objectives of the laboratory are pretty clearly defined, or that the research area is specifically defined. Once this is done then it is relatively simple for the director to carry on, and there does not need to be a great deal of direction from elsewhere over and above the usual annual reviews of projects, budgeting, and so on. But, it is true that some of the scientists might not be assigned to a specific project, but simply assigned an area in which we need to do something, or an area in respect of which we need more information.

The case of the rapeseed, which is written up here, is a good example of a study in which you get into a whole realm of other subjects, running all the way from nutrition to genetics, to bio-chemistry and bio-genesis, and so on, which require some fairly basic science. I think they made a great deal of progress on this, but you cannot direct too rigidly from Ottawa. I think the director on the spot has to assess these problems, and decide how he is going to deploy his resources.

The Chairman: But, in defining the function or vocation or mission of these regional labs, how do you go about this? Are you trying to tell them that they should put some priority on regional problems?

Dr. Schneider: I might say that these laboratories were first set up with regional concepts in mind. This applies to both the Saskatoon and the Halifax laboratories. The original concept was that they would be regional laboratories. But, I do not think the Saskatoon laboratory, in particular, ever really operated in that way, except that there was an attempt made during its first few years, but it soon became apparent that if they were to run in all directions trying to solve everybody's problems they would end up doing nothing well. They realized they had to concentrate on certain problems that they considered most important, and ultimately this rapeseed problem was one of them. At one time they were trying to make building board or pressed board out of straw, and so on.

The object of the laboratory originally was to find a use for agricultural waste, and then we got into a period where that problem disappeared, and the function of the laboratory has changed. But, in the sense that it is a regional laboratory for the Prairies, the problems it is concerned with certainly cover that area, but it has never really functioned as a regional laboratory in the sense that people were bringing local problems to it. Perhaps the term "regional laboratory" is a misnomer. However, the function of the laboratory is reasonably well-defined in the general area of plant bio-chemistry as related to problems of crops, and so on.

The Atlantic laboratory is now starting a fairly long term program in the area of marine agronomy. It is concerned with the development of breeds of marine plants that can provide an economic benefit. When you think of the thousands of miles of coastline that we have upon which marine plants can grow, then it can be realized that the possibility of developing such plants that can then be harvested for their food value or chemicals, or what have you, is very important. This is a new kind of science. Perhaps the Japanese are working harder at this than anyone else, from the point of view of additional food sources, and a source of chemicals and other biological materials.

Senator Thompson: I suppose there would always be a close contact with the work done by the Japanese, the Americans, and others?

Dr. Schneider: Oh, yes.

Senator Thompson: I was interested a short time ago to see a film on the work done in Holland on pushing back the sea and reclaim-

ing the land. In this respect again I presume you would keep in close contact with what is being done by other nations?

Dr. Schneider: Yes, there is no question about that, although you should not associate this type of work with the Halifax laboratory. The Halifax laboratory is not concerned in this area, which is the area of marine hydraulics and harbour installations. This is done by Dr. McPhail's division here in Ottawa.

I might mention that at the Atlantic laboratory about a year and a half ago there was an international conference held on the utilization of sea weeds, which was very well attended by people from all countries. There is a tremendous interest in this now. This is something that makes one think of the work that has been done in agriculture in breeding new species of crops with certain characteristics and properties. This has not been begun with respect to marine plants. There are a great many species, particularly on the Atlantic seaboard....

Senator Robichaud: It is getting to be a major industry.

Dr. Schneider: Yes, it could be.

Senator Robichaud: It is.

Dr. Schneider: There is some harvesting now, but it is on a pretty small scale.

Senator Robichaud: I think in Prince Edward Island it is being done on what I would call a large scale. There are four plants operating now in Prince Edward Island, including the one that the Department of Fisheries built as a model.

Senator Thompson: How would you relate the marine research laboratory at Nanaimo with this one at Halifax?

Dr. Schneider: There is a relationship only in the sense that they keep in close contact and work closely together. In Halifax you have the Bedford Research Institute, which is sponsored by the Department of Energy, Mines and Resources, and which is concerned with oceanography. Then there is the Institute of Oceanography which the NRC supports at Dalhousie. At Nanaimo I presume you are referring to the fisheries station?

Senator Thompson: Yes.

Dr. Schneider: We also support the Institute of Oceanography at the University of

British Columbia. This whole area of marine science is one that I feel is going to be very, very important for Canada, and it is one that is being studied now. We are concerned about developing this in a rational way, because there are many universities that have an interest in this.

The Chairman: And many federal Government departments?

Dr. Schneider: Yes. We have started this, and we have a preliminary report, and it is now a study being undertaken by the Science Council. I think it deserves serious study because when you think of the Grand Banks with its tremendous resources, and the thousands of miles of coastline that we have, then it is obvious that marine science is an area in which there are real opportunities for Canada in respect to future development.

Senator Grosart: Mr. Chairman, I hope we will get back to Senator Cameron's question.

The Chairman: Yes.

Senator Cameron: I have to leave quite soon, Mr. Chairman, and I want to put this question. Is it practical to establish a sort of national inventory of research projects—that is, projects that are in hand, projects that have a high priority, and projects that are further in the future? On the other side of the inventory there is the manpower available. The third leg of the triangle would be the physical resources, the plant in government, universities and industry. Is it possible to establish this kind of national inventory to help us formulate a policy for the long range?

Dr. Schneider: I would say to a degree, but I should like to hear what Dr. Tupper has to say on that.

Dr. Tupper: The question is obviously aimed at trying to find good methods for the decision-making process. I think it is perhaps desirable—and I offer this as a suggestion—to call some of the Treasury Board staff before you some day.

The Chairman: They will come eventually.

Dr. Tupper: I think it might be wise to do it early.

The Chairman: We were told they were not in a hurry.

Dr. Tupper: At the present time there is a well-developed system of program review leading to the preparation of estimates. The

whole process practically becomes an annual cycle; by the time you have gone round the cycle to get the Estimates tabled in the house it is time to begin the next program review. The decision-making process is done this way, and it is an entirely different way from comparing items on a million item list. It would not of course be a million; it might be 10,000. You do not decide by starting down at the bottom with all the bits of things to compare one with the other. The decision-making process works the other way around. You have first to settle the broad areas. I think it would be most useful if the present decision-making process were understood before you looked at the alternative ways of doing it.

Senator Cameron: One of the reasons for asking that is that on looking through the NRC review of 1968 I notice a listing of a number of projects and the number of staff engaged on them. For example, in applied chemistry there are 62 projects and a staff of 90, which is a ratio of 1.4 men per project; in applied physics, 38 projects and 75 staff; in the division of building research, 101 projects and 86 staff, which gives a ratio of .85 men per project; in mechanical engineering, 145 projects and 77 men; in the Prairie region lab, 49 projects and 35 people. This suggests there are a lot of very small projects, which would tie in with your suggestion that a lot of the things done may be one-day or ten-day projects, something like that. I just wanted to get the picture. Would this represent the majority of the work, which would be small projects?

Dr. Schneider: I think this kind of arithmetic is probably not too fruitful, because a lot of these are small bits of a larger program and one has to see the whole before being able to assess it.

Reverting to the earlier question of whether we could make a list of the important things to do, I would say that one could do this with larger projects. Of course, this is supposedly one of the things the Science Council should worry about. I do not think you can make it too fine grained, because the situation changes. In decision-making, a project may look good today but next year you may find it is impossible and you have to go on to something else. Even when you have decided the priorities, it is one thing to have a nice decision-making policy here and decide what you would like to do. What is more important is what is possible, either because

of technical reasons or because of budgetary reasons. There are these two things that enter into it.

Senator Grosart: Is not the real question what we *must* do?

Dr. Schneider: Right.

Senator Grosart: Surely this is the real question.

Dr. Schneider: Even there, you see, there are some serious problems before us.

Senator Grosart: There will always be serious problems.

Dr. Schneider: There will always be serious problems that we must do something about, but if we have not the technical background or the know-how to do something about it it is very difficult.

Senator Grosart: But if you say that these are projects we *must* undertake, then all the other problems disappear. If you say "We must," then we *have* to get the facilities and the people. It is inherent in the concept of "must" that you do it.

Dr. Schneider: When you make such a list and say that these are things we must do, you find there is enough money to do about half of them and you still have to make some other decision.

The Chairman: Are you trying to use these so-called new methods of technological forecasting in defining your programs?

Dr. Schneider: I think I will let Dr. Cook add something to this. Technological forecasting is something you can do when you already know a great deal about it, how you are going to do it and so on. When you still do not have the technological know-how, when you are starting way back, this kind of forecasting is probably very unrealistic.

The Chairman: Dr. Jantsch referred to these methods in his report published by OECD. In fact, they are not precise yet, but they are certainly developing and there are several institutes in the United States which think there is sufficient value attached to these methods that they use them and try to improve them.

Senator Grosart: What they call the "science of science," is it not?

Dr. Schneider: It is a very difficult problem, and anything we can bring to bear on it

and any new tricks we can learn about it is all to the good. I would hesitate to try to approach a problem like nuclear fusion for power and try to project this. Do you have anything to add to this discussion, Dr. Cook?

Dr. Cook: The subject of technological forecasting is very popular nowadays. I have been very close to it for the last four or five years. I think I personally know nearly all the people who have taken part in it, and I have been at nearly all the conferences. Instead of discussing it for an hour I think I will just summarize my conclusions and let it go at that.

First of all, there is nothing whatsoever new in the techniques. Techniques which are being very widely discussed as if they were new can be summarized in one word, just common sense.

Senator Grosart: Hear, hear.

The Chairman: Certain of those methods involve sophisticated common sense!

Dr. Cook: I do not think I would even agree with that. I am familiar with, I think, all the methods being promoted, and I believe I can say without question that they are relatively old methods, and to specialists in the field could scarcely even be called sophisticated. What is important and what has often been missing is the will to write down on one sheet of paper all the things you know about the particular problem or field and then take a good square look at that sheet of paper. All too often there are too many vested interests in not writing everything down on one sheet. You know, you want to look at one part of the picture that favours the conclusions you wish to come to. The most important thing in technological forecasting is to decide (a) that it is important to do, which it is, and (b) that you are going to have the courage to face up to the results when you have got them all written down on one sheet; but I think we should not make the mistake of thinking there are any mysterious, mystical new techniques that are going to make the future easy for us. That is not the case.

Senator Aird: How do we overcome the lack of will?

The Chairman: By a presentation of someone who wants to do some research in the field, but does not want to present the whole story to his superiors.

Dr. Cook: You know what Shakespeare said, "Screw your courage to the sticking point."

Senator Aird: How do we eliminate the vested interests?

Dr. Cook: I do not think you can ever eliminate the vested interest; you have to screw your courage.

Dr. Schneider: There is another aspect of this, if I may add. I think all of these things certainly have to be done at the same time. It must not be done in such a way to completely destroy or discourage initiative. I think that is a very important part too. They succeed in the end because someone had the conviction it was a good thing and was prepared to fight for it. This is very often how things get done.

The Chairman: I am really surprised. Perhaps I am talking too much today. I am surprised a little bit by what Dr. Cook has just said, because after all there are several institutes in the United States which seem to specialize in technological forecasting and they seem to do very well in monetary terms. If they do that well and if these methods are very old methods and are not too useful then there are a lot of people around or near the scientific community which are very naive.

Dr. Sullivan: Mr. Chairman, I am not at all surprised at what Dr. Cook says and I like his philosophy. I think it is very good. In the future, Dr. Cook, there is a very good verse you could use instead of Shakespeare's:

The Craftsman there, the Smith with that metal of his,

With these tools, with these cunning methods;

How little of all he does is properly his work!

All past inventive men work there with him,

As indeed with all of us in all things.

Hon. Senators: Hear, hear.

Senator Hays: I was wondering, in the field of common sense, you have all these various agencies that you are advising on research programs. Do the various agencies take these to the Treasury Board or do you take them to the Treasury Board on their behalf? I am thinking of agriculture. Say the research people say that they need \$30 million and these are the programs. Do you have difficulty with the new programs or the old programs? It seems to me that when I used to go to the Treasury Board somebody would be pretty

keen about yanking one out. Every time I would go he would have it yanked out and I would have to go back and if I did not go back often enough it would die. Sometimes certain ones I thought were not important would be completely overlooked.

The Chairman: Do not forget, Senator Robichaud and I were members of the Treasury Board.

Senator Hays: I realize that.

Dr. Schneider: I am not sure whether I quite understand the sense in which you meant it. You used the word advise.

Senator Hays: I am wondering whether the Treasury Board were advising you or whether you were advising them in some cases.

Dr. Schneider: I would hope that we are putting a program before them, making proposals and then we would hope that we would make a good enough case and it would be supported. We do not advise any other research agency in the sense that perhaps you understood it. When we perhaps do some joint programs with the Department of Agriculture or any other agency it is not a question of advising, it is a question of either mutual consultation or co-operation, but ultimately they have to make their own decisions and we have to make our own decisions when it comes to specific cases.

Senator Hays: This does not present a problem as far as you are concerned?

Dr. Schneider: It is not a problem, no.

Dr. Gauvin, Member of the National Research Council and Manager, Noranda Research Centre, Pointe Claire, Qué.: Obviously, the senators are groping here with a question of tremendous importance, the establishment of programs and how we go about it. Actually this has been the substance of a great deal of discussion today. I would submit that a good starting point in order to initiate a program, to assess it, and to set priorities, is the need for criteria. Nobody seems to be concerned about the establishment of criteria, probably because it is a horribly difficult job. Nevertheless, it is necessary. What is going to happen of course is that different programs unfortunately will require different sets of criteria. When the Science Council talks about major programs obviously the social, and the economic criteria will be of tremendous importance. The industries represented are

quite interested in those major programs in the long run, but to be quite frank, we are becoming increasingly interested in what we might call intermediate programs. Those are programs which a firm by itself cannot tackle because of their scope; but an industry could tackle them with the support of our major partner, the silent partner, the partner that makes most money out of any new venture resulting from the fruits of research to the extent of about 75 per cent of the profit thereby. It is quite logical that industry would look forward to the establishment of such significant programs. It is not too difficult to imagine that certainty. For example, in the mineral industry we desperately need new methods of remote sensing. We are beginning to have a weapon to tackle such programs, but as a rough estimate this work might require \$10 million a year. No firm in Canada that I know of could alone properly support such a program, but you see the criteria immediately would be different from those for major programs.

The Chairman: I am sorry. I know that Senator Cameron has to go very soon and he wants to put in a last question I think.

Senator Cameron: I wanted to say, Mr. Chairman, that first of all I think this has been a very useful day and personally I was very pleased to have these 35 projects spelled out here. I think it was a very useful exercise and I think we all feel more familiar as to what is actually happening. There is one small point, in looking through it, however, that just puzzles me. Whether this is policy or not I do not know. In the field of human relations and personal relations there is hardly a mention of the people who have done a lot of these projects and one of the ways of attracting and maintaining a corps of young and enthusiastic people it would seem to me would be if we took every opportunity of giving them a plug where it is deserved. Here I am sure there are many names associated with various projects and it would not have hurt to have had their names mentioned. I would like to see it done.

The Chairman: It would be not only useful for us but perhaps also for this mysterious body which advises the Governor General for the Award of Canada Medals.

Senator Cameron: Senator Harry Hays has been stoking fires out west and he tells me it is about 40 degrees below today, so I will

have to go and see if I can blow up a chinook.

Senator Grosart: I have no comment on No. 10. No. 11 deals with rapeseed and I know Senator Hays is waiting to get into that.

Senator Hays: I do not know I have too much to say about rapeseed. I think this is an excellent job that the Government has done. It is outstanding. It shows we are in this sort of field where there is a great deal of room. I think that the work generally has been greatly improved and especially some of the work on the germ wheats.

The Chairman: Is the acreage expanding very rapidly?

Senator Hays: I think it can expand just as the market will be able to take it up. The Japanese are very much interested in this sort of thing, but it is easy to grow—the job that they have done could be a very major program. I think this is an excellent job.

Dr. Tupper: If you produce too much, the bottom drops out of the market price.

Senator Grosart: The figure is $1\frac{1}{2}$ million acreage devoted to rapeseed production. There is one reason I think this is interesting. On page 50 it says:

As a result of this overall program rapeseed oil is now being used to supply 25 per cent of the vegetable oil requirements in the manufacture of margarine and shortening in Canada.

This is a tremendous benefit and I presume the cost-benefit ratio here would be very high. Could you tell us just as case history, Dr. Schneider, where the impulse came from to get into that? This was a crop that we did not grow at all and now there are $1\frac{1}{2}$ million acres of it. Where did the impulse come for the NRC to get into it?

Dr. Tupper: I am not sure I can add very much to this write-up, which discusses how we got started. It goes back to the last war, when some rapeseed oil was used for another purpose. If you would like a little more background here, Dr. W. H. Cook is with us. He used to be director of biosciences and was closely associated with this in the early stages. Perhaps he would say a few words.

Dr. W. H. Cook, Executive Director National Research Council: Mr. Chairman, it started in the last war, when we had the problem of growing rapeseed as an industrial oil. This

established that the crop could be handled with the same machinery and grown under the climatic conditions of Western Canada.

At the NRC, Ottawa, we did some work on it, immediately after the war, because rapeseed had been used as an edible oil and we never had a larger edible oil crop in Canada at that time. We of course grow flax.

In consulting industry afterwards, they never seemed anxious to use rapeseed oil, but we found they were interested in getting rid of erucic acid—an unusual fatty acid—at a time when many fatty acids were suspect in connection with cardiovascular disease, and so forth. Industry asked if this could be removed. Thus, on top of all the testing program, was the original work done by the Canada Department of Agriculture and ourselves, they doing the plant breeding and we developed a method of analysis leading to the production of a variety that contained no erucic acid.

The impetus came from the last war, followed by the limited use of rapeseed as a source of edible oil throughout the world and the need to improve the composition to yield an edible oil satisfactory to industry. We believe we have improved it.

Senator Grosart: I think we could move on to the next group—we have 12, 13, 21 and 22 which are all on the aviation field.

No. 12 is airborne magnetometry. This is one that brings the NRC into the area of the Defence Research Board and Defence Production. Have you any reservations about the NRC taking on projects that have a direct defence or military connotation?

Dr. Schneider: In a general way, if we are asked to aid in a specific project where we have special facilities and so on, we would certainly do everything we can to help. As a matter of course, we would prefer not to work on classified work but in this particular case, since it is a purely defence matter and, as it turned out, had tremendous applications and potential in other areas, it made it that much more important as a project.

Senator Grosart: May I move on to No. 13, which is the low speed wind tunnel. On page 59, the second paragraph:

In these circumstances, it has been the policy of the Canadian government to concentrate all its national resources of development wind tunnels in the National Research Council, and this has proved to

be technically and economically an excellent solution to a complicated problem.

It seems to me to bring up the question of concentration of scientific effort versus diffusion. We have both patterns here. Following Senator Cameron's question, my concern is the fantastic number of science policy decisions that are being made. We are constantly told there is co-ordination. Most of the departments of Government are making science policy decisions. They are making decisions to support science projects in universities and some of our witnesses have told us "when we make our decision this year we do not know what other decisions are being made with respect to those same universities."

The suggestion was put to us, and I was very interested in it, that we should first of all find out what the present decision-making process is, before we address our minds to what the future one might be. I would assume this is what we have been at for a couple of hundred hours now. We have asked numerous people and no one has given an answer, except the two-word answer: "Treasury Board".

It seems that our national science policy today is not forecasting, it is hindcasting.

It seems to me, from the evidence we have had here, that departments manage some co-ordination. They discuss—there is no question about that. But finally it all goes to the Treasury Board. I hope we will have some evidence as to what criteria the Treasury Board uses.

For example, to come back to this page 59, where does the decision come? This is described as a policy decision of the Canadian Government—this is the thing we are concerned about—to concentrate all national resources in this area in the National Research Council.

Now, are these decisions, to diffuse or concentrate the science effort, Canadian Government policy decisions? Would you so describe them?

Dr. Schneider: May I start first by saying that since the NRC role pervades so many areas of science, we are always very conscious in decision making and policy making decisions, because it may affect a lot of other industries and other Government departments. Therefore, if anything, we lean over backwards in making sure there is prior consultation and evaluation and so forth.

Senator Grosart: I do not doubt that.

Dr. Schneider: In this specific case, there exists, you may know, an interdepartmental committee called NARC—the National Aeronautical Research Committee. This is an inter-departmental committee at the deputy minister level, where all such matters having to do with aeronautics are brought. They are backed up by what is called a technical advisory panel, which includes all the people with technical expertise and so on. Therefore, in this particular case, there is pretty well organized and effective decision-making. If a proposal comes through, this then has the support of all the departments involved and, if it goes to Treasury Board, the decision-making has all been laid out. I think in this case the decision-making is relatively simple.

Senator Grosart: Tell me, Dr. Schneider, how and by what instrument has the Canadian Government stated this as a policy? Where do we get this program from? This is a policy. This is the first time I have seen, in all the evidence we have had, a statement of a Canadian Government policy on science. Is there an instrument or is this somebody's concept of what the policy is? Is there a Government White Paper? Is there a resolution. Is there an Order in Council? Is there a resolution of the Treasury Board?

Dr. Schneider: May I first say that this is not a policy for science. This is simply a policy of development in the aeronautical industry.

Senator Grosart: This is a science policy.

Dr. Schneider: It is one part of it, yes. As I mentioned, the decision-making is through these bodies, and perhaps Mr. Thurston might want to add something to this. I do not know whether there exists a paper which says this is Government policy.

The Chairman: I presume that once the interdepartmental committee has discussed these problems and has come to a conclusion, the conclusion is that the decision is for you to start a new program on this, and, well, you put that in your Estimates and discuss it with the Treasury Board and then it is either rejected or approved by the Treasury Board, which means that there is a decision of the cabinet, and it goes to Parliament and the Estimates.

Dr. Schneider: That is correct.

Mr. Thurston: This has been described, Mr. Chairman, in both these terms. The fact is that the National Aeronautical Research Com-

mittee was set up in 1951, I think, to provide for the economic provision of certain equipment and the monitoring of aeronautical programs. Since they were set up by the Government, one assumes, naturally, that what they do is Government policy. This is the sense in which the words were used here. Governments do not customarily, at least I do not suppose so, write policy concerning such relatively trivial issues as building a wind tunnel, but the actions of their agents, which in this case is the National Aeronautical Research Committee was to produce the maximum of support experimental equipment for the aeronautical industry at the lowest price.

Senator Grosart: It is an assumption that certain actions of certain people at the moment constitute Canadian Government policy. It could be changed tomorrow by another interdepartmental committee decision.

Dr. Tupper: I wonder if there is not semantic problem here. If the word "practice," which is much the same as "policy," were substituted for "policy," would that be agreeable?

Senator Grosart: I would agree entirely. My point is that the use of the word "policy" in connection with science policy of the Canadian Government seems to me a misnomer, and, Mr. Chairman, I am not being political in saying that. This has been going on for a long time.

Dr. Tupper: Please read "practice" for "policy" in our document.

Senator Grosart: I would agree.

The Chairman: But the practice is a result of policy in Government.

Senator Grosart: Sometimes.

Senator Thompson: I am thinking that the wind tunnel was \$2½ million, as I understood it. It was one of your larger projects. One of the unique things about your presentation in comparison with some other presentations we have had is that there is no project that I see here about which you say you would like to have completed it, but were cut off. I am thinking, for example, of ING; and we had Veterans Affairs people tell us that a number of medical research projects they were doing were cut off because finances were dropped.

Do you account for the fact that you are not stating that any major project has been cut off on the basis of your approach to the Treasury Board, namely, that you are bold

and daring and you fight through with the Treasury Board on this? Is it a fact that some people are to timid or is it a question of common sense? Just why are you unique?

The Chairman: They have been very well treated by the Treasury Board. That is the only assumption you can make.

Senator Thompson: I just wondered if there had been a major project cut off, as happened with such projects as ING.

Dr. Schneider: My stewardship of the Council, as you know, is relatively recent. I do not know how many projects have been cut off in the past. But, certainly, in a lot of cases, if we cannot get resources for a project one year, we may have to delay for another year.

While I am on the point, and since you have raised it, we do have a project we would very much like to get on with. We would like to build a new National Science Library, which we hope will be possible before too long. This is becoming increasingly important, because the whole question of scientific information, its storage and dissemination and so on, is exceedingly important.

As you know, there has been an information explosion, and more and more laboratories across the country are going to be dependent upon such a library. We have completely outgrown our present library, and some of this will have to be put in dead storage. But this is going to be at least a \$13 million project. Thirteen million dollars is the present estimate, but this has had to be shelved for the time being. You wanted an example so I have mentioned that.

Senator Thompson: Senator Grosart's question about how decisions are made is still something on which I am still very unclear. Having been in politics myself, I would suspect that with your wind tunnel the aeronautical industry had been in approval of your starting this, had presented a brief to the Government, had pushed for you on it, and a number of others might have done so as well. This, of course, raises the question of criteria. We saw with ING that there were two different points of view, whether they should go ahead on it, and I think that is a very healthy way for the Treasury Board, or anyone else, to make a decision. I suppose, for example, that in respect of your wind tunnel it was not a question of both pros and cons being presented. I suppose it was just pros all the way.

Dr. Schneider: Certainly, in the case of the new 30-foot wind tunnel, the whole case rested on the need by the aeronautical industries.

Senator Thompson: So that if an industry is interested in some particular innovation, it is a good approach for that industry to lobby the Government to the effect that NRC should start it.

Dr. Schneider: Of course the aeronautical industry is something special and it operates in a different way. We have several, but none is as large as the big American companies that can afford facilities of this kind. That is primarily the reason why these are shared facilities. Whether this would work in other industries is another matter. If it were an individual industry I don't think the case would be very strong. But in other sectors a good case should be made if there is one.

Senator Grosart: Still dealing with case No. 13 on page 61, towards the bottom of the page, you made the statement "...that the flow of foreign research material into Canada has been maintained as an act of reciprocity for a much smaller flow of similar material from the National Research Council into other countries." Would this apply to the total flow of scientific information in Canada?

Dr. Schneider: It is just a question of numbers. We are a small country compared with some of the larger countries.

Senator Grosart: Is this a specifically directed flow or is it information that you get from technical papers?

Dr. Schneider: It is a flow which would probably be rather difficult if we didn't ourselves have some first-rate facilities and researchers who keep contact with other researchers and have contact with other laboratories. It is almost a sort of price of admission. There is a research group which is very active in this area and who arrange to get special publications and so on.

Senator Grosart: And who also have the capacity to absorb and utilize the information.

Dr. Schneider: Exactly.

Senator Grosart: If I might move on, Mr. Chairman, to the next item in the aviation sector, which is No. 21. It deals with the crash position indicator on page 90. This is apparently another case where a small Canadian company came to the rescue. Again was there any reason why the larger companies which

were in this field were not interested? How do you approach these people? What kind of turnaround do you get from the big companies? Do you give them a dossier on it? Do you send somebody up who is enthusiastic and say "Wouldn't you like to take this on?"

Dr. Schneider: If we could take the specific answer first and then we could discuss the general problem—

Mr. Thurston: The specific answer is that two or three companies were given licences and they were unsuccessful in building up customer interest. They failed in the marketplace. They did not achieve contracts in substantial numbers. The result of that was that we withdrew their licence to manufacture and found somebody with more initiative. This resulted in the Leigh Instrument Company being chosen and making a success; and the success resided primarily in their ability to win large contracts from the United States. The extent to which it is commercially successful in Canada is quite small, but it is very successful in military aviation in the United States. Now with regard to the size of the company, it is the sort of thing that a large company I think on the whole would be a bit suspicious about. It was apparent from the start that very large contracts were not to be easily had because it is a rather specialist kind of device and it often has to be specially tailored for the airplane on which it is fitted. Now, big companies rather tend to prefer longer production runs. This kind of thing customarily does not find a great deal of favour in large companies.

Senator Grosart: One then assumes this is an example of NRC not taking the original turn down as a final answer, but continuing to probe until you could find someone interested?

Mr. Thurston: This is one of the finest examples of a dedicated man I know. This particular man was told to stop this job in 1958. He was again told to cut it off in 1962. He did not. Eventually he developed \$15 million-worth of business out of it.

Senator Grosart: A wonderful case. It certainly proves the general statement about the importance of the dedicated individual in this field.

The last case directly in the aviation field is 34 on page 133. This is the 30-foot wind tunnel. I have no specific comments here, Mr. Chairman.

The Chairman: Was that not a bad project?

Senator Grosart: No, this tunnel is in operation now.

Dr. Tupper: It is in the final stages of construction.

Senator Grosart: It is expected to be in operation in March.

Dr. Tupper: Yes.

Senator Grosart: This was a case where NRC was approached with the proposition that there was an urgent industrial requirement, and you were apparently the only one prepared to undertake it and bring it to fruition. Is that the case here?

Dr. Schneider: Yes. As you know, there was discussion as to whether it should be sited elsewhere, and the decision was finally made, not on the basis of any whim or anything else, or a desire to centralize things, but rather on purely economic grounds. As a matter of fact, at the time this decision was made there was a particular concern on the part of Government about excessive concentration of things in Ottawa, and, other things being equal, they would probably have preferred to see it elsewhere than in Ottawa, but in the end the decision was made, on savings and other advantages that would accrue by putting it in Ottawa.

I do not know whether you wish to discuss this point further. Perhaps Mr. Hiscocks might wish to add something to it.

Mr. R. D. Hiscocks, Vice-President (scientific): I would like to mention, having recently come from the aircraft industry, that NRC is failing to state it operates these tunnels as a service to industry. The opportunity to use these tunnels for research on the part of NRC occurs very rarely because industry uses a number of these tunnels on a round-the-clock basis, and has for many years. Though experts will argue whose idea it was first that there should be a large low-speed wind tunnel, the industry was pressing for this many years ago.

The Chairman: Should they pay for its use?

Mr. Hiscocks: Industry contributes towards the cost of the operation.

Senator Grosart: What is the total cost of this low-speed tunnel?

Mr. Thurston: The present estimated cost is \$6.5 million. That was estimated, and with the

tolerance of 10 per cent which we are customarily allowed to overrun it would be about \$7 million.

Senator Grosart: How much does industry contribute—that is, the people who are using it?

Mr. Thurston: Industry has not contributed anything financially up to the moment. It has contributed a certain amount of skill, and so on, and representatives of industry have served on the committees which designed the thing. But, industry has contributed no money.

Senator Grosart: Would you say there are a great many of these research areas where there is an urgent need for research or testing facilities by Canadian industry, and which Canadian industry itself cannot finance?

The Chairman: And it is not used, we understand, by NRC.

Mr. Thurston: Our tunnels are used by NRC, sir. When Mr. Hiscocks says they are a service, it is for only part of the time that they are a service. When they are not being used by industry they are used for research.

On the more general question, I think it can be said without much doubt that if the Government is prepared to seek various kinds of equipment that can aid industry in a pretty direct way they will undoubtedly find such equipment.

Senator Grosart: What I am getting at, Mr. Thurston, is how is the decision made. Suppose the detergent industry came in and said: "We need to test enzymes and their effect in a washing machine". Who would make the decision? We are building this low-speed wind tunnel because the Canadian aircraft industry cannot afford it, but we are not setting up any research equipment for Procter and Gamble.

Mr. Thurston: Well, sir, I think to answer that question one really has to take quite a sharp look at the nature of the aircraft industry here and in other countries. The fact is that the competitors of our own industry are heavily supported by Government funding. This funding comes in a multitude of ways. It may not necessarily be direct, as it is in the case of the wind tunnel. I think you can be sure that the foreign companies that have wind tunnels have received substantial contributions to their cost from Government contracts of a defence nature. The

question immediately arises: What do we do in Canada about this? Do we let our aircraft companies fend for themselves, or do we provide some equipment for them? I have discussed this with the Treasury Board, and they accept entirely the premise that this is a very reasonable way of supporting an industry which has enough difficulties already.

Senator Grosart: Yes, I am not in any way being critical. What I am interested in is establishing the fact that in this whole R&D field in Canada we have a different picture from that in the United States, and certainly from that in most of the other leading industrial nations, for reasons that I need not underline. Out of it seems to emerge the fact that the NRC has as its specific function in this area the provision of facilities for industrial organizations in Canada to innovate and produce. Could you give us a percentage of the NRC effort that goes into direct assistance to industry?

Dr. Schneider: This would be a very difficult question to answer, particularly when you call it direct assistance, because there are many kinds of indirect assistance.

Senator Grosart: I will leave out the word "direct".

Dr. Schneider: Certainly, I would have to say that the major part. . .

The Chairman: This is apart from your grant system.

Dr. Schneider: Yes. I would say that the major part of our research effort is industrially related. Of course, we do a number of other things that have to do with subjects like photogrammetry, which has to do with surveying, and so on—and ultimately it is industrially related as well—fire protection, and health, and others that might not fit into the industrial sector. But, I would say the bulk of our work is industrially related.

Senator Grosart: The point I am making is that this relates directly to this problem of proliferation that I spoke of.

Dr. Schneider: Which problem?

Senator Grosart: The proliferation problem of agencies where the Government in so many ways is obviously trying to spark Canadian industry to do more research, with tax incentives, direct grants and so on. It seems to me that the NRC function is perhaps, we would hope, a temporary one in this

area, and that the time will come when by and large Canadian industry will be able to do far more research than it is doing. The evidence we have had is that we are lagging behind all the other OECD countries in industrial research, in research funded by private funds.

Dr. Schneider: I think one has to consider each case on its merits. There are certain industries where some large test facilities are necessary, and somehow or other this has to be made available to the industry. A good example is the electric power industry which has need of a big facility, and I understand there are plans for Quebec Hydro to build such a test facility, which is very badly needed in the country. The building industry also needs test facilities, and since that is a fragmented industry no one company is likely to have these facilities. I think in individual industries there is a case to be made for having certain test facilities somewhere in the country.

The Chairman: In this case, if the industry were not to use these facilities would you still require them for your own operations?

Dr. Schneider: No. I would say that, had it not been for the industrial requirement the 30-foot wind tunnel would not have been built at NRC. Would you agree with that, Mr. Thurston?

Mr. Thurston: We have stipulated from the beginning of the 30-foot wind tunnel enterprise that it was not for the National Research Council in any shape or form, that it was an industrial tunnel.

The Chairman: This is a direct subsidy to industry which is not really appearing in the other government programs. I do not say it is a wrong thing, but it does not appear as assistance to industry in our system of accounting.

Mr. Thurston: I would like to agree with that, if I may. It is true that this is a point of view on the way one would describe it in its initiation. You do have to remember, however, that wind tunnels last for at least 25 years. For instance, the one on which all the industrial support work is being done in the National Research Council at the moment was built around 1941, and in the last six or eight years it has done ten times as much work as it did in all the preceding years. When one builds a wind tunnel one is really providing for quite a distant future for the most part. I

would ask you to believe that when you invest in a tunnel of this kind—and I should tell you that it will be the finest tunnel of its type in the world—you are really investing from two points of view: the immediate industrial point of view and its long-term advantage to the country as a very valuable scientific installation.

The Chairman: My only point was that when we look at the different government assistance programs to industry and make a total of the amounts, what you are doing in this case in particular does not appear there.

Mr. Thurston: There is one further point in this; industry does pay to use it, you know, sir. It does not get the services free. We have contracts with industry for every job we are doing.

Senator Thompson: Would not the purposes I presume of your contracts with industry in connection with trying to get industry to develop research, be that you find the lack of research in industry in Canada is because there would be parent companies in the States, where they would have most of their major research facilities and therefore they are not interested particularly in starting research in Canada?

Dr. Schneider: This is certainly a very big factor, but I should also add, it varies considerably from one company to the next. It is very difficult to generalize here. Certainly Canada has gained a great deal by imported technology because of the subsidiary companies in Canada associated with a parent company which has a large R and D facility. As I say, these also vary considerably from one company to another, but we would also hope in the future that there might be some other kind of development where some of these companies might specialize more particularly to the Canadian scene and do both R and D and production in Canada.

Senator Grosart: Mr. Chairman, the next case is regarding the regrinding of destroyer escorts' reduction gearing. According to the account here we now have one of the best shops in the world for the heat treating and precision grinding of gearing. This is on page 64. It continues:

In the course of events, the intermittent work allowed the skill to deteriorate and the interests of the managing company and of the Government diverged to the point where it was decided to close down the shop and sell the machinery.

The DDP turned over the machines to the National Research Council on the undertaking that the NRC would bring the shops up to a standard which would meet our NATO requirements. Now, this is a rather interesting case where there is a failure within Canadian business to provide the facilities to meet a fairly normal requirement we made with NATO. In this case NRC took over the whole thing and we are now one of the finest shops in the world. Again, you are assuming a Canadian national responsibility. Business fell down on the job for perhaps understandable reasons, but here again you step into this gap. This of course brings up the matter that Senator Thompson raised. We all admit the benefits and perhaps the necessity of American and other investments in Canada. We do have problems because you could not expect an American company to undertake this research for the parent company—to undertake research that Canada was required to do to keep its NATO commitments.

We have the development of an airborne flight simulator which is on page 73. Here again we have the NRC stepping in to fill a national responsibility arising out of a Canada—United States inter-government agreement to develop a tactical aircraft guidance system. Is this another case where nobody in Canadian industry was able to undertake this?

Dr. Schneider: You are referring to this last paragraph on page 77, are you?

Senator Grosart: That is right.

Dr. Schneider: Perhaps we might have more explanation from Mr. Thurston.

Mr. Thurston: This particular agreement I understand that has just been consummated is designed to produce what is in effect a helicopter flown by wire. That is to say the pilot has no direct contact with his controls; he is operating with electronics.

The issue here is that it is a triplicated system involving stable platforms and quite a variety of very sophisticated equipment. Of course, it is no part of the NRC duties to look after the provision of this sort of equipment, but it is in our view our duty to examine and prescribe the limits of capability—for instance, the limits which are imposed on the aircraft by the form of programming that is built into the computer system. That is work which can rationally be done in what is in effect a fly by wire system in a simulator, and the results that we get will allow a design,

which will go to Canadian and United States companies, to go on in a rational way.

Senator Grosart: In other words, you do this before the prototype machine is manufactured?

Mr. Thurston: It is much more likely to be done in parallel with some of the hardware development.

Senator Grosart: On page 82 in regard to river development, there is reference from the Department of Transport, division of mechanical engineering, which decided to investigate the locks on the Welland Canal. How did the NRC get into that?

Dr. Schneider: The NRC for many years has had a hydraulic laboratory, which we started I believe during the war years, about 1938, and which has been doing a lot of work on various harbour installations, waterway installations, and river problems and so on. It was largely because of this continuing work, and this of course also had to do with things like the Baie Comeau breakwaters and things we discussed this morning. So there was a capability there and this particular development required some examination. Perhaps Dr. MacPhail might give a very brief explanation?

Dr. MacPhail: Could I remark, first of all, Mr. Chairman, about the Welland Canal. As you know, a waterway like that is rather like a roadway that, up to a certain point, it will carry more and more traffic and then it quite suddenly chokes and you probably are well aware that it is not very far from choking at the present time and that there has been an energetic piece of work by the seaway authority and also by the various consultants to examine the various queuing arrangements for ships to get them through in time.

You are also undoubtedly aware that there is discussion as to how the canal should be enlarged in capacity, whether by twinning, as it is called—although already it is partly twinned—and whether in fact, if it were twinned the locks should be built to the present size or to the size of the Sault Ste. Marie locks which are larger.

The fact of the matter is that this is a piece of work we did entirely on our own initiative and we had access through the seaway authority to the sources of the trouble and delay. That let ultimately to the simple fact, as everyone knows, that starting and stopping the ships is a waste of time and if you want to avoid this the way to do it is to keep them

going. So, in fact, we laid out a new canal system for them through an appropriately chosen piece of terrain and presented them with a report. This was on our own initiative. It was not on any other initiative at all.

Senator Grosart: Why would you undertake that initiative when the Seaway Authority, although it has not a profit, seems to be able to get along very well with its deficit? Why would NRC spend some of its money on something which seems to be so obviously an obligation on the Seaway Authority?

Dr. MacPhail: The reason for this is quite simple. Periodically, we have discussions with all the engineering staff of the Seaway Authority and the people of the Department of Transport. Being seriously-minded people ourselves, we do not like to see all this time wasted in the way of lost traffic, tied up shipping and so on. That particular piece of work is a piece of paper work. It was quite an easy piece of work which took a man about two months to do.

Senator Kinnear: May I comment on that, Mr. Chairman? I come from that area. In fact, the Welland Canal goes through my city. I would say that the monitoring of the ships through the canal is a marvelous feature. Everybody in the area had sent in ideas on how to increase the speed of ships getting through the canal. Now it seems to be handled very nicely with this monitoring system. In St. Catharines, however, they do come to a bottleneck when they get nearly to the southern end where the canal is going to be left untouched from the new part they are putting in. Starting about three miles north of the beginning of the canal from Lake Erie they are doing about an eight and a half mile stretch of new canal. It is very wide and they will not stop and there will be no bridges, but they will have the bottleneck at the southern end where it is not going to be touched, and all the ships will have the same bridges to go under and the people will have that great delay. I wish NRC would come up with a brilliant idea of how we can get back and forth in that very busy area without waiting for bridges. I understand, in fact, that they are going to add a third bridge at Port Colborne.

It is a very pressing problem, because every ship that wants to move through the Great Lakes area has to go through that canal and go on through there.

Dr. MacPhail: I would like to say, Mr. Chairman, that this is precisely what our report covers.

Senator Kinnear: How to get around the bottleneck?

Dr. MacPhail: How to avoid the bottleneck and how to avoid time being wasted from the passing of ships; how to reduce the passing time of ships. It is, we believe, possible to cut it from about 14 hours to about five hours.

We had, ourselves quite a lot to do with the design work on the locks in the seaway, which are patterned on the Welland locks in terms of size and in terms of quite a number of other design features, and the result of this kind of interchange to which I have referred, there are a number of suggestions which we have made being put into the Côte St. Catherine locks and St. Lambert locks.

There suggestions are related to the fact that in order to save manpower the Seaway Authority requires a ship to put ashore people to handle its own lines. Well, as you know, the available deceleration of a big ship, a big Great Lakes bulk carrier, is very, very slow, and hitting a concrete wall is, in the view of the shipmaster, a very poor thing. The result is that the approach techniques of these people are quite naturally very conservative indeed. There are ways of easing this problem which have been evolved in other parts of world for the handling of super tankers, and since we have contact with research organizations all over the whole world we, in fact, import these ideas.

Senator Grosart: From the policy point of view, my interest in this case is to ask you whether NRC regards it as part of its responsibility to look over the whole field of science and pick out areas of deficiency of initiative, as you have done in this case, and say to people like the Seaway Authority "Here is something you are missing. We have taken a look at it and we are going to do this ourselves and show you how." I am not being critical. Is this part of the general policy to do this?

Dr. Schneider: I think you are raising a very good point. Let us say in the building construction industry where NRC has a responsibility, a total systems responsibility. Then the transportation area is one that has grown up over the years with excellent co-operation between NRC, the Department of Transport, the railways and the aircraft companies and so on. I think we will have to

develop in this field and this is something we will have to study jointly. It will be necessary to work out a greater overall responsibility, the kind of thing you were talking about, in the research area, in the technical field, because more and more in some of these things we have problems referred to us, but it is all part of a total problem, if you know what I mean. Sometimes one can solve the separate problem, but sometimes one would do better to study the total problem because one might then discover that the solution was not necessarily the best one. This is one area we need to look at and we must have some discussions on this. The whole transportation area is a very big one and one which I understand the Science Council will be doing a major study on.

Senator Grosart: This is the kind of case referred to quite often where you are responding to a technological problem and find you have to go back and do basic research arising out of the analysis of the technological problem. That would be the kind of case, would it?

Dr. Schneider: Yes.

Senator Grosart: Then, Mr. Chairman, coming to No. 19 dealing with bird hazards to aircraft, which is to be found on page 83. On page 86 you say "This investigation exemplifies the close-knit co-operation of a variety of agencies (made possible through the mechanism of an NRC associate committee)." Will you tell us what would be the structure of these committees, how many there are and are they ad hoc committees?

Dr. Schneider: No, the associate committees are not ad hoc committees. They are set up by our council, their terms of reference are set by our council, and their members are appointed by our council. They are set up to deal with a number of important national problems which cover a very wide area and which require expertise from various areas, so usually the members appointed are selected because they have special knowledge or expertise in the area. They come from industry, from universities, and from government laboratories, or wherever there is an input to the problem. Once their terms of reference are set they meet periodically, and study these problems. They decide whether there should be a particular course of action and they frequently recommend a course of action to our council. Sometimes they will also sponsor research or recommend what research

should be done. They may even say what is the best agency to do it and what results of research should be put into effect. Now at this time I believe there is something between 35 and 40 associate committees. Some of these eventually, when the problem disappears or they solve it, disband, and new ones get formed, and so on. They are listed in our first submission.

Senator Grosart: Case 20, page 87, the analytical plotter. Here is the case, quoting from page 88:

Since there were no Canadian companies producing and marketing this type of instrument, no Canadian industry could undertake the development and exploitation of this remarkable invention.

So it went to a foreign company, and the royalties to date are \$280,000 under Canadian Patents and Development Limited. This is another case where our own industry is not set up to follow up one of your remarkable discoveries.

Dr. Schneider: I might add that there is a new company which has just been formed which will be taking up a new development in this area and producing it in Canada—in fact, just outside of Ottawa.

The Chairman: It may be difficult though to compete with the other one.

Dr. Schneider: They are different types of instrument. It is another type, but in the general area of photogrammetry.

Senator Grosart: We have dealt with everything now up to 24, which is on page 99. I have no comments there, Mr. Chairman.

25: cold storage of food.

Senator Robichaud: On cold storage, this is a project which is of great interest from coast to coast, because it deals with frozen food. I am pleased to note that the industry has taken advantage of this because at present about a dozen commercial storages of the jacketed type are in operation in Canada, and the CPR and the CNR have put into service about 150 of these jacketed truck trailers.

What means, again, does NRC use to make this information available to the trade or general public? Are these findings published in magazines dealing with refrigeration, for example? I ask this question because I am sure there must have been problems of condensation, say, causing ice formation between

the inner and outer wall with this type of refrigeration. I believe they call it lensing. Is this information available to the general public?

Dr. Schneider: Yes, most of this information is published, except where there is patent action, and even then it is published once the patent applications have been made.

Senator Robichaud: In this case have there been any patents taken?

Dr. Schneider: I am afraid I cannot answer that.

Dr. W. H. Cook: No, the development was not patentable.

Senator Grosart: Twenty-six on page 104. It seems to be another case where a large industry, the electronics industry, as I read on page 105, did not show much interest in the work, but a Toronto manufacturer saw the possibilities and now has, I think, a \$15 million—or, anyway, is developing a very large market for the microwave dryer.

Dr. Schneider: This is just beginning to take off. It is suddenly turning out these microwave drying techniques are finding applications in so many directions, and I think this will develop very rapidly. There is a possibility that has to be looked at, and this will possibly have to wait for higher power magnetrons and microwave generators, a possibility in the pulp and paper industry where they could be used on a large scale and greatly reduce the cost of drying in the processing there.

Senator Grosart: This is where the National Film Board had a problem and referred it to you, and in solving that problem you opened up a very large commercial area.

I am almost through, Mr. Chairman. Case histories 28 and 29 are the two references from the railways. In one case it was the air brake and the welded rail. I have not really any questions there. I assume from the report that the Canadian railways work in very close co-operation with you, and refer many of their problems to you.

Dr. Schneider: I should mention also that there is a NRC associate committee on railway problems.

Senator Grosart: I am surprised that you are not getting more money out of these people for the work you are doing.

The Chairman: From the CNR do you mean?

Dr. Schneider: It comes from the same pocket, does it not?

Senator Grosart: It is the people who have the deficits who have the most money—the CNR, the Seaway, and the CBC. They are the rich people. I think we have discussed 31, the sealed double glazing. Here is a case, as I read page 122, where out of your research work you came up with a national standard. Were you able to impose that? This was, as I understand it, a case of where a well-known patented glazed...

Dr. Schneider: I believe that this was really more a standardized testing technique so that the manufacturer could guarantee performance, rather than there being a standard imposed that was going to be used throughout the country.

Senator Grosart: Did the two big companies that originally had the monopoly on this become annoyed at you for showing the small companies how to compete with them?

Dr. Schneider: I do not have that information.

Dr. Tupper: I think I can speak briefly to that. Our work was not concerned with how to make a successful double-glazed window, or how to design it or manufacture it. Our work was the problem of testing so that the manufacturer himself could tell, when he marketed this thing, whether he was going to have to replace them all at his own expense in three years, or whether they were going to last. This was, you might say, an accelerated life test to ascertain the behaviour of the window as it is cycled through hot, cold, wet, and dry cycles hour after hour and month after month. From that work a testing technique was evolved, and I believe a specification has been written by the agency which used to be part of the National Research Council but which is now part of the Department of Trade and Commerce or the Department of Industry for the use of Government purchasing. That specification is available to any one who wants to use it, but it simply specifies the performance that must be met by the product. So far as the various manu-

facturers are concerned, they will still have to find out how to meet it themselves.

Senator Thompson: I am thinking of Japan's industrial development, and I am wondering if there is any situation in which you might take some product, analyze and break it down, and suggest that Canadian industry could work on it. In other words, have you ever looked at something in the building industry, for example, in that fashion—or would you say that that is unethical?

Dr. Schneider: I am sure that the industry does this all the time. It looks at competitive products, and analyzes them, if that is what you mean.

Senator Thompson: I am thinking of it in the context of the Canadian construction industry which, as you say, is fragmented and does not have any research facilities, yet we have particular problems with our climate, just as we talk of this double glazing.

Dr. Schneider: Certainly our Division of Building Research is in very close contact with what is being done in all other countries, so they have all this information available. As you point out, we have some special problems in Canada which other countries do not have.

Senator Grosart: I have come to the end of my questions. As I have been the main inquisitor here today may I, Mr. Chairman, with your permission thank our distinguished guest witnesses for the very adequate way in which they have answered the questions, and as far as I am concerned for the concept I have of the importance of the National Research Council and the very great contribution it is making to Canada at the government industrial level and the international level.

Dr. Schneider: Thank you very much.

The Chairman: I am sure Senator Grosart has expressed the view of all of us here. Perhaps I might add on behalf of the other members of the committee that we should be grateful to Senator Grosart for the patient work he has done in looking through all these cases with his usual critical mind. Again, Dr. Schneider, thank you very much indeed.

The committee adjourned.

APPENDIX

APPENDIX 22

A SUPPLEMENTARY REPORT
PRESENTED TO
THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY
PRESENTED BY THE
NATIONAL RESEARCH COUNCIL OF CANADA

29 JANUARY 1969

NATIONAL RESEARCH COUNCIL OF CANADA

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THE SENATE
CANADA

October 28, 1968.

Dr. William G. Schneider
President
National Research Council
Montreal Road
Ottawa 7, Ontario.

Dear Dr. Schneider:

This letter is to follow up the comments made to you at the time of the Committee's hearing of the National Research Council brief regarding the Committee's requirements for additional information. Specifically, on behalf of the Committee, I am hereby requesting that you supply the Committee with information in response to certain items mentioned in the Guideline, namely:

a) re Section 2.9, page 12,

"1) For each unit responsible for scientific activities, (intramural or extramural), list the titles or other brief descriptions of projects which were conducted during each of the years from 1962 to 1967 inclusive. Indicate projects that are part of an overall programme and briefly describe the programme."

"2) Present case histories of what you consider as the most significant completed projects of the last five years. These should be selected as exemplars of what are considered to be the results of the agency when operating in its role with maximum effectiveness; in other words, examples of what the agency considers among its "best work". The projects selected, when possible, should be presented under the broad categories of "basic research", "applied research", and "development", and it is suggested that no more than five are to be singled out in any one category."

b) re Section 2.7 - a) page 9,

"1) Describe process whereby various types of programmes and projects are selected, initiated and monitored (e.g. what role do other Federal agencies or units play in this process)."

.../2

"2) How are priorities established between programmes and projects and in what terms are priorities expressed and implemented."

I realize that presenting fuller information regarding your programmes and associated projects may be a time consuming task. Nevertheless, the Committee would like to have a fuller and clearer picture than that presented in your report. Perhaps it would be appropriate for you to concentrate on those programmes and projects which are not concerned primarily with basic or fundamental scientific research; in other words, concentrate on projects closer to the applied or developmental end of the spectrum.

As mentioned to you during the hearing, the Committee would like the projects you selected for mention in Part IV-4 of your report presented in the form of detailed case histories. The case histories should be complete enough to give the members of the Committee a realistic view of how scientific activities are actually carried out. If you have any questions regarding this please do not hesitate to contact the Committee staff.

I hope that the Committee can accept your invitation to visit some of your laboratories early in the new year.

Yours sincerely,

A handwritten signature in cursive script, reading "Maurice Lamontagne".

Maurice Lamontagne.



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RESEARCH

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NATIONAL RESEARCH COUNCIL
CONSEIL NATIONAL DE RECHERCHES
CANADA

OTTAWA 7.

29 November 1968.

The Honourable Senator Maurice Lamontagne
Chairman
The Senate Special Committee on Science Policy
The Senate
Ottawa, Ontario

Dear Sir:

I wish to acknowledge with thanks your letter of 28 October in which you indicate areas where additional information would be valuable to your Senate Committee. I am most grateful for the opportunity to provide more detailed information in respect of how scientific activities are actually carried out, particularly insofar as our first hearing tended to focus on the broad policies and issues pertaining to science policy.

To assure an effective presentation, I am writing to seek clarification of some items mentioned in your letter. In respect of section 2.9.1 (listing of research projects) I have reviewed our earlier presentation, with particular reference to the transcript pages 96-102 and 175-199, and discover the focus is primarily on the Intramural Program, and constitutes a listing only in respect of one year. To follow this guideline more accurately we should perhaps list all of our research grants in universities, and provide a coded list of company projects pursued under our Industrial Research Assistance Program. It appears that such a listing would run to approximately 250 pages for each of the five years involved. The bulk of the material we would propose to supply is available in the Annual Review of Activities, and the Annual Report on Support of University Research, a copy of each is attached. We are fully prepared to undertake the compilation of such a listing if the Committee would find it valuable. I would appreciate your further guidance in this respect.

The Honourable Senator Maurice Lamontagne

-2-

29 November 1968

With reference to section 2.9.2 (case histories) we appreciate that these may greatly assist the Senators in developing a realistic appreciation of how scientific activities are actually carried out. It is proposed to provide at least fifteen detailed case histories. A number of these would be related to those projects mentioned in our earlier brief. Each case study would be developed with reference to a four-part outline. First, an introduction indicating how the whole (program) (project) (mission) came to get started, including statements on who made what decisions and why. This would be followed by a brief description of the technical aspects, namely: what the technical work was, how it was mounted, financed, and done, including who authorized the funds from what source, etc. Following this, the economic and/or social aspects and implications would be developed. The last part of each case history could be a description of what important points it illustrated, such as co-operation with other Federal Departments and/or industry.

With reference to sections 2.7-a.1 and 2.7.a-2 (program selection and priorities), while a number of the case histories would directly illustrate these processes, we would propose a brief paper be prepared on these subjects to pull together such generalizations as may be objectively arrived at in the light of our experience.

I also note the suggestion that the emphasis in the further information should concentrate on projects closer to the applied or development end of the spectrum. Am I right in assuming that this suggested focus applies to all four questions set out in your letter?

Please be assured of our desire to assist your Committee in its important task. We will be most happy to provide any information desired by the Committee and to discuss it with them.

Yours sincerely,

W. G. Schneider
President

Encls

c.c. Mr. P.J. Pocock

Special Committee

THE SENATE
CANADA

OTTAWA, December 10th, 1968.

Dr. W. G. Scheider,
President,
National Research Council,
OTTAWA 2, Canada.

Your File: 3-12-S5-1

Dear Dr. Schneider,

I am replying to your letter of November 29th, 1968, regarding your submission for further information to the Committee by the National Research Council.

In your second paragraph you point to the problem of presenting detailed lists of N.R.C. projects. I suggest that in order to reduce the burden on your staff that you concentrate on preparing an annotated list of Intramural Research projects, indicating when appropriate the programmes to which they are attached; this list need not be prepared for each of the five years but for a year at the beginning and end of a five year period, for example, to the current year and 1963. The Committee would also appreciate receiving a list of projects pursued under your Industrial Research Assistance Programme; the information can be given for the same two-year period mentioned above. For the present moment, the published information regarding your support of research in Canadian universities is sufficient.

The Committee will look forward in receiving your detailed case histories. I do not think that you should concentrate on case histories that are closer to the applied or development end of the spectrum. What the Committee requests are case histories of what you consider as some of the most significant completed

.../2

projects of the last five years regardless of whether fundamental research or development was involved. The Guideline does suggest, however, that when possible case histories should be presented under the broad categories of Basic Research, Applied Research and Development.

Yours sincerely,

A handwritten signature in cursive script, reading "Maurice Lamontagne". The signature is written in dark ink and is positioned below the typed name.

Maurice Lamontagne.

INTRODUCTION

A key point in Senator Lamontagne's letter of October 28 is "...to give the members of the Committee a realistic view of how scientific activities are actually carried out." It is a pleasure to respond to such a request, and we have prepared case histories of 35 projects and programs from NRC which we hope will provide such a view. It may be helpful in studying them to have a few special points in mind.

It is sometimes thought, and perhaps the wish is father to the thought, that there is or ought to be some fairly standard pattern in those research projects which have been successful and have led to substantial economic consequences; there is or ought to be, one might think, some pattern of success in the origin of the ideas, the selection of which ones to pursue, the monitoring of the research program, the establishment of priorities, the funding, and so on. It is an unfortunate fact of history that no such pattern emerges. Each successful project or program seems to have a pattern all its own, differing nearly always in major respects from every other. If this is disconcerting to those who must fund research, it is even more disconcerting for directors of research who would welcome a pattern for success more than anyone else.

This conclusion about a lack of pattern is one which one would hardly dare draw from the experience of one laboratory alone. Indeed one needs to look at dozens of examples from dozens of

laboratories the world over. We have available a particularly useful background collection of some 60 case histories of technological innovations all of which impact our economy today in a major way, and many of which originated in laboratory research. Each one is so uniquely different in its whole pattern of selection, initiation, monitoring, funding, etc., that it convinces us that our NRC experience is not at all surprising.

However, a few useful generalities do seem to emerge from the study of a wide variety of such case histories - and it will be useful to have them in mind in studying the 35 NRC cases.

These generalities are:

1. The economic impact of discoveries and inventions coming from laboratory research during the last few decades has been enormous, much greater than is generally realised. One of the problems is that these impacts are often so large that they baffle the economist or accountant who tries to measure them. This is one of the major problems of research management. When the economic benefits of a particular program or project become large and widespread, it becomes difficult to decide how much - or how little - should properly be set off against the original research costs. A single example will illustrate - how much has the initial research done at DuPont between 1928 and 1932 which resulted in the discovery of nylon, been worth to DuPont, to the U.S., to Canada, to the world? Trying to measure this with any customary accounting or economic indices seems like trying to measure

kilowatts with a yardstick - somehow it just doesn't work. Several of the NRC examples have this peculiar character.

2. The initiation and completion of successful programs and projects, are rarely clear-cut. An example will illustrate. One can quite properly attribute the initiation of the research program which resulted in the nuclear powered submarine, to almost any date from 1896 (when radioactivity was first discovered) up to the initiation of the specific submarine engine project in the early 50's. And although the world now has two large nuclear-powered navies, the research programs are far from completed. This elusiveness of beginning and end is one of the baffling problems a director of research has to face. Under pressure, usually for accounting reasons, he may sometimes make specific statements about initiation and completion, but usually he has to be rather arbitrary about it and frequently gets himself in trouble over it. Normal accounting control rules are, for research programs, often a Procrustean bed!

3. It is often said that the time gap from a research result to its economic fruition is shorter now than it used to be, and getting shorter; that things are going faster. This has not been our experience, and the 60 case histories we have from the experience of others, seem to support our experience. One of the fastest and most dramatic examples involves the discovery and application of X rays. They were discovered in October of 1895 and within two months were being used in hospitals. One of the slowest was hybrid corn which took literally decades - and

has had its real economic results only since World War II. It still seems generally true that today's economy is very much the child of research done 5 - 15 years ago (and more); and that the research we are doing today will in the main have its real impact on the economy of 5 - 15 years hence. We all would like to think otherwise - but those seem to be the facts. And this poses a major problem. How much should be spent out of this year's budget as an investment in Canada's economic growth and well-being 5 - 15 years out? This is a very painful question, not only for the nation, but for individual companies. Money spent today hurts today; the enormous benefits 5 - 15 years out always seem a little vague - especially since we cannot know specifically exactly what they will be. About all we can do is to presume that the experience of the last several decades is still pertinent, and that some of today's "expensive" research programs will turn out 5 - 15 years hence to return solid gold. In several of the NRC case histories we are sure the payoff will be large, but we know it is 5 or more years off.

4. The last generality which is worth keeping in mind, because it does not and cannot show in a written "case history", is the importance of able and dedicated people. In every single successful case history we have ever studied (including the 60 we have mentioned) there was such an individual. Of course many dedicated men never produce results which have economic impact - but we know of no case where a research program was "successful" that there was not at least

one dedicated and effective man driving it along. Apparently no amount of monitoring, controlling, priority setting and other managerial techniques alone will induce successful research programs. Indeed, from the 60 case histories (and our own experience) one is almost forced to the awkward conclusion that those which are "managerial" successes must be generally technical and economic failures, for they do not seem to turn up in the success lists. This is at least as disturbing to research directors as it must be to those charged with supplying funds. This is the reason why research directors sometimes seem so diffident about "monitoring, controlling, and priority setting", because they know from bitter experience that these things play little role in the success of a research program. What does play a crucial role, however, are the conditions of work - the existence of an environment which attracts and stimulates effective and dedicated people.

Many people have had the thought that the study of case histories of research and development programs which were failures would be particularly educative, and lead to constructive proposals on how to avoid failures. However, everyone who has tried this approach has found it sterile. It is difficult enough to get reasonably reliable case histories of successes, and just about impossible for failures, and for very human reasons.

There is a serious basic problem in our technological economy. Our financial and business world is geared to annual

accounting and budgeting. The whole history of the economic impact of research of the last 50 years indicates that for a technological growth economy only 10 year accounting and budgeting makes sense. Annual accounting fitted the buggy-whip business; it really makes little sense for a computer business and it makes no sense at all for research programs. This basic time scale conflict is the origin of most of the misunderstanding and difficulty of dialogue between the research director (who has to work on a 10 year scale), and the accountant, businessman, or government leader (who is called to account annually). Frankly we do not know the answer to this critical dilemma, whose seriousness is becoming increasingly apparent to many business executives.

There is another serious basic problem in our technological economy. There are technical areas of critical national interest which are not really amenable to any kind of economic justification or discussion. They will never lead of themselves to "economic growth" in any direct sense, nevertheless if not tended to, properly and adequately, they could choke off the whole economy. Examples of this type of area are environmental pollution, transportation (water, land and air), resource conservation (e. g. forests), public safety, education, national defense, and medical services and general health. Such "social problem" areas lend themselves uneasily to "economic" discussion but lend themselves easily to "mission" discussion. The problem of just what should be done, and on what scale, is correspondingly more difficult

to settle.

Finally a comment on the categorisation of research into Basic, Applied, and Development, is necessary. These words are commonly used in a general way both by scientists and others as broad loose categories in general discussion. In practice, however, when one gets down to specifics, it is almost impossible to get agreement on any specific project as to which category is correct. In fact, like beauty, the nature of the categorisation depends a great deal on the eye of the beholder, and every beholder sees it differently. Most such definitions involve the "attitude" of the scientist rather than anything factual about the nature of the work itself.

Nevertheless in a broad general way the case histories have been arranged in order with those that most scientists would consider more basic first, and the more applied ones following, with a special group of three, illustrating particularly involved and difficult decision-making, at the end.

RADIO ASTRONOMY

The NRC radio astronomy program started in 1946 with studies of the radio noise from the sun. Since the sun's emissions greatly affect radio communications, and even the safety of astronauts, the data provided by continuous solar patrol maintained by NRC for the past 21 years has been extremely valuable and widely utilized. In recent years radar emissions from many other celestial sources have been intensively studied by NRC scientists, and to aid this program one of the finest radio telescopes in the world was designed and installed at the Algonquin Radio Observatory. One striking application of this instrument was in combination with radio telescopes at Penticton, B.C., and at Jodrell Bank, England, to yield very high resolution measurements of the diameters of the recently-discovered and very mysterious "quasars". This same long-baseline technique can also be used to measure the distance between two widely separated points on the earth's surface to a much greater accuracy than any existing method can provide -- great enough to measure the almost imperceptible drifting of the continents.

The early transatlantic radio telephone service was often interrupted by radiofrequency noise of unknown origin. In 1932, Karl Jansky, of Bell Telephone Laboratories, using a rotatable antenna, showed that much of the interference was caused by radio waves from a particular area of the sky, from some stars or constellations in the centre of the galaxy of which our sun and planets are part. Later work by Reber, with better antennas and receivers for the short wavelength radiation, confirmed the galactic radiation, found it at shorter wavelengths, and mapped the intensities.

This new science of radio astronomy, pioneered by Jansky and Reber, grew rapidly after World War II. Many workers in different countries built antennas and receivers designed to locate more accurately the sources of the radio waves, and to measure the energy characteristics of the radiations from these waves.

During World War II, it had been found that radar stations were occasionally jammed by some mysterious interfering shortwave radiations; these turned out to be from the sun and to be a many-fold increase in intensity of the radio frequency energy normally emitted by the sun. After the War, in 1946, the Radio and Electrical Engineering Division of the National Research Council began a research program investigating these radio emissions from the sun. Soon after commencing these solar observations, a partial eclipse of the sun provided data that suggested that the strong radio emissions came from small local regions on the sun's surface.

To confirm this, however, required a radio antenna, or radio telescope, that would receive the 10-centimeter wavelength radio waves from the sun and had a resolution sufficient to identify the region of origin of these on the surface of the sun. To achieve the needed resolution, the antenna must be more than 75 feet in length, and yet suitable for the 10-centimeter waves. In 1951 the Division completed such an antenna, 150 feet long, and, with the angular resolution obtained with it, was able to show that the interfering radiation came from the small dark areas on the sun's surface known as sun spots. This was the first identification of the sun spots as the source of the intense radio emissions.

Shortly thereafter, the radio astronomers of the Division developed a technique, now widely adopted throughout the world, that increased the angular resolution of an antenna system by a factor of

two over that normally obtained. Today, using this technique, the NRC's Algonquin Radio Observatory has an antenna system -- known as a compound interferometer -- with an East-West resolution of 15 seconds of arc: this is a resolution four times better than that of any comparable instrument in the world.

In its study of radio emission from the sun, the Division has monitored the radiation at the 10-centimeter wavelength continuously since 1947. The data from this, the largest unbroken series of such observations in the world, have been used by scientists throughout the world and have contributed much to our knowledge of the sun.

Solar flares, or explosions, on the sun greatly affect the transmission of radio signals used in the telephone and other civil and military communication systems, so a close watch on solar radio emissions is kept by several radio observatories. Information on these emissions is transmitted to a centre in Boulder, Colorado, and from this information predictions are made of solar activity and of the radio frequencies that will offer the best transmission. Solar radio data from the Algonquin Radio Observatory is sent to Boulder daily and is an important part of the information used for the predictions, which, in turn, are sent to Canadian organizations using radio communication.

In another area of radio astronomy, the study of radio sources in our galaxy and outside of it, Canada began to participate in 1957, and a search was conducted for a site for a National Radio

Observatory. A suitable one, free from the man-made interference that had increasingly diminished the usefulness of the Ottawa instruments, was found in Algonquin Park, at Lake Traverse. This site has now been developed into the Algonquin Radio Observatory and is equipped with some of the finest instruments in the world for radio astronomical research. The equipment includes a 150-foot-diameter, dish-shaped, parabolic antenna that can be aimed at any point of the sky and can be kept pointed at that area as the earth turns. This radio-telescope and the other facilities are used by university astronomers and their graduate students and by the NRC, and by the Observatories Branch of the Department of Energy, Mines and Resources. Foreign astronomers have also been given the use of the facilities for special research programs.

An area of increasing interest in radio astronomy has been the study of quasars -- strong sources of radio emission outside our galaxy, discovered a few years ago. Many of these show large fluctuations in the intensity of the emitted energy over a few days to a few weeks. All seem to be very far away. The nature of these sources, the immense amounts of energy radiated, the periodic variation in emitted energy, and other characteristics, such as the angular diameter, are riddles of intense interest to astronomers. Canadian radio astronomers from several universities, the Dominion Radio Astrophysical Observatory at Penticton, B. C. , and the Algonquin Radio Observatory,

with the 84 foot antenna or telescope at Penticton, the 150-foot telescope at the Algonquin Radio Observatory, and the 1900-mile baseline between them, were able, using an interferometric technique, to determine that the apparent diameters of several quasars were between 0.02 and 0.06 seconds of arc, and that the diameters of three or four others were less than 0.01 seconds of arc. This successful use of the long-baseline interferometric technique was highly satisfactory: these were the first such measurements made and the measurements agreed with theoretical predictions. Similar measurements were made a little later between the Canadian stations and Jodrell Bank, England.

This interferometric technique, successfully developed for the quasar experiment, has future application in three other areas:

- 1) it can be used to determine the separation between stations on the earth, and ultimately the position of each station, with far greater accuracy than is now possible with any other method;
- 2) it can be used to measure minute variations in the rate of the earth's rotation;
- 3) it can be used to confirm, or to disprove, the theory that the continents are drifting on the surface of the earth.

THE PROTEOLYTIC ENZYMES OF A MYXOBACTERIUM

A marked ability to disintegrate other bacteria possessed by a new type of bacterium isolated from Ottawa soil was traced to two distinct enzymes which are secreted. It was discovered that the first of these enzymes is closely related to the digestive enzymes of the human pancreas; the second disintegrates certain round worm parasites of man, and has other very selective effects. Both enzymes have potential commercial applications - patents are pending, and one major company in Canada is awaiting clearance to explore commercial production.

The Myxobacteria are a group of soil-bacteria. In 1964, a research team at the dept. of Agriculture isolated from Ottawa soil a myxobacterium with an unusually marked ability to lyse (i.e. to disintegrate) certain other bacteria. The lytic agent was secreted into the medium in which the myxobacterium was grown and crude preparations of it were used by the Dept. of Agriculture group to further their studies on the structure of bacterial cell walls. We concluded from their preliminary data that the lytic agent was probably a muramidase. These are well known and widely distributed enzymes - present, for example, in hen's eggs and in human tears - which disintegrate bacteria by cleaving the carbohydrate components of bacterial cell walls. As work on the isolation of other muramidases was in progress in our laboratory, it seemed worthwhile to attempt to isolate this one as well and, with the help of the Dept. of Agriculture group, the myxobacterium was grown on quite a large scale. A purification procedure was devised and proved to be extremely effective

but it also proved there were two lytic agents, not one; both were proteases (enzymes that cleave proteins), not muramidases; and, apart from being proteolytic and bacteriolytic, the two enzymes had nothing whatever in common with one another. One was named the α -enzyme; the other, the β -enzyme.

Later on, it was found that this myxobacterium also secretes at least 4 other proteases which are not bacteriolytic. They have been designated the γ -, δ -, ϵ - and ζ -enzymes. The ϵ -protease has just been isolated (Dec. '68); isolation of the others is in progress.

Theoretical Significance

1. The α -enzyme. This enzyme has proven to be the only known bacterial protease with the same types of amino acid sequence at its catalytic sites and the same operating mechanism as the digestive enzymes secreted by the human pancreas. (Part of the proof was made possible by a reagent prepared by the Suffield laboratories of the Defence Research Board.) The reaction mechanisms of the pancreatic enzymes have been studied intensively for many years as, apart from their relevance to the digestive processes of man, they are relevant to many other biological processes as well - e. g. enzymes of the same type are intimately concerned with the transmission of impulses in nerve cells. One of the most widely accepted hypotheses was that their catalytic activity depended on an interchange

of hydrogen ions between two residues of the amino acid, histidine. As the α -enzyme contains only one residue of this amino acid, it could not possibly function by such a mechanism and it provided the first direct refutation of the twin-histidine hypothesis.

An enzyme can be likened to one or more strings of 20 different sorts of beads, the beads being the 20 amino acids from which enzymes are constructed. On this analogy, the α -enzyme is a single string of 200 beads, cross-linked by sulfur bridges at 6 points. A determination of the complete amino acid sequence, i. e. an identification of each of the 200 beads, was started about 2 years ago in collaboration with a research group at the University of Alberta. It is now almost completed and should be finished very early in the coming year.

2. The β -enzyme. This enzyme has some quite spectacular effects on some complex substrates - e. g. it lyses not only certain bacteria but also certain round-worm parasites of man and other mammals and it cleaves proteins in quite a selective way - but, until very recently, all attempts to determine how it functions were blocked by failure to find any simple substrate which the enzyme would attack. This problem has now been overcome and a detailed study of the β -enzyme is underway. The present indications are that it is unique.

3. The γ -, δ -, ϵ - and ζ -enzymes. Little is known of these in detail but at least two of them are like the α -enzyme in that they are "serine-proteases", i. e. proteases in which a residue of

the amino acid, serine, is the reaction centre of the catalytic site. The remarkable thing about this particular set is that each enzyme has a different sequence of amino acids around that serine residue and, in fact, these three enzymes represent every known type of such sequence. They provide therefore a unique opportunity to determine how such sequences are inter-related and how they evolved.

Potential Applications

These enzymes may prove useful in two general sorts of ways: - (1) in applications which exploit the proteolytic activity of the entire set (the use of crude proteases as household stain-removers is one of the most recent examples of such an application) and (2) in applications which exploit the specific properties of individual enzymes - e. g. the antihelminthic properties of the β -enzyme. Patents on the α - and γ -enzymes are pending and one major Canadian company is awaiting clearance for collaborative research with a view to possible commercial production of these enzymes.

STRUCTURE AND PROPERTIES OF FREE RADICALS

Most chemical reactions proceed through a number of intermediate and short-lived molecules called free radicals. Only in recent years have techniques been developed for producing these short-lived species in sufficient quantity so that their spectra can be obtained, thus permitting a determination of their structure and properties.

For many years chemists have known that there are a large number of steps between the initial and final products of a chemical reaction and that many of these involve short-lived molecules known as free radicals. For example, in the burning of methane, which is the principal ingredient of natural gas, the initial reactants are methane (CH_4) and oxygen (O_2) and the final products carbon dioxide (CO_2) and water (H_2O), but in the flame, molecules such as CH_3 , CH_2 , CH , C_2HO_2 and OH are known to exist. These intermediate species have a very short life but are essential for the reaction. Similar short-lived species occur in most chemical reactions.

Although it was postulated that these free radicals occur in many chemical reactions, and that they in fact control the type and speed of a reaction, for many years their presence was inferred from the type and speed of the reaction rather than from direct observation. In chemical investigations of this type, the chemistry divisions of NRC have had a long and distinguished

history. It is, however, only in recent years that the properties of the simple free radicals have been determined directly and in this new work the spectroscopy section of the Division of Pure Physics has played an outstanding role.

The discovery of the absorption spectrum of a molecule at once gives a method of investigating whether or not a particular component is present in a chemical reaction and if present, in what proportion, and over what period of time. But the spectrum also gives a great deal more information. From the spectrum the geometric structure of the radical, i. e. the distance between the atoms and their spatial arrangement, can be deduced; the vibrational frequencies of the molecule, which influence its thermal behaviour, can be measured; the energy necessary to break a chemical bond in the radical may be determined and the nature of the energy states, which are of great theoretical interest, can be determined. Thus once the spectrum of a molecule has been recorded, it is possible to determine most of its properties and this may be done even though no pure sample of the molecular species has been isolated and even though the molecule exists for only a few millionths of a second.

The study of the spectra of free radicals has formed a major part of the program of the spectroscopy laboratory of the Division of Pure Physics. It has been found that a concentration of free radicals sufficient for observation can be obtained by

decomposing stable molecules either by an intense flash of ultraviolet light or by a short intense electrical discharge. Methods have been devised for photographing the absorption spectrum in a few microseconds. The spectra have been recorded on large spectrographs such that the fine details of the spectra can be studied and information regarding the molecule can be measured precisely.

The spectra of some fifty different free radicals have been observed and analysed and the results have been published in some hundreds of papers in scientific journals, and in a recently published book. The results of this work have been used to check theoretical calculations on the shapes and sizes of molecules, to identify spectra in flames, discharges and astrophysical sources, to monitor chemical reactions and to advance our knowledge of the motions of electrons and nuclei in molecules and the relationship between these motions and the spectra. Two examples are given to illustrate in more detail the nature of the work being carried out.

For many years it has been known that in the emission spectra of comets, there is an intense spectroscopic emission band in the far violet region (4050A) and later the same band was observed in absorption in stellar spectra. The explanation for this band was unknown and it was not observed in any laboratory source. About twenty-five years ago the spectrum was finally reproduced in the laboratory, but even then the nature of the molecule emitting the spectrum was uncertain. In the spectroscopy laboratory at NRC

a series of experiments with the emission spectrum showed that these bands originate from a triatomic carbon molecule (C_3), but although the emitter was identified unambiguously, much of the spectrum was too complex to be analysed. Subsequently it was found possible to obtain experimentally a sufficient concentration of C_3 to photograph its absorption spectrum and this absorption spectrum could be analysed. From this spectrum we now have a fairly detailed knowledge of the three carbon atoms lie on the same line with an interatomic distance of 1.277×10^{-8} cm and that compared to most other molecules it is very readily bent. The molecule is of great theoretical interest since it is one of the simplest triatomic molecules of which we have detailed knowledge. Also following the identification of the C_3 spectrum it has been shown that this radical plays a major role in physical and chemical processes (such as combustion) involving carbon, since under a wide range of temperature and pressure it is the most abundant species in carbon vapor.

A second example is the methyl radical CH_3 , which is known to play an important role in many chemical reactions. A very large number of stable organic molecules contain CH_3 groups attached to other atoms and during chemical reactions they become detached and form very reactive free radicals. Although this fact was well known, a positive identification and structure determination of CH_3 was lacking until its spectrum was observed in experiments carried out in the spectroscopy laboratory. The CH_3 was obtained

by the decomposition of a stable molecule by an intense flash of ultraviolet light and its spectrum was obtained a few millionths of a second after the CH_3 was produced. A study of the spectrum has given the geometric structure of the radical and a number of its properties. Equally important, the CH_3 absorption spectrum occurs in a convenient spectral region and can be used to determine the concentration of CH_3 in a chemical reaction vessel. Such investigations are now being carried out in a number of chemical laboratories. This the discovery of the CH_3 spectrum was aided by the earlier chemical work but now the spectrum has become a tool to improve the chemical studies. The work on the spectrum of CH_3 is not complete since theoretical studies predict a weak absorption of great theoretical interest in the near ultraviolet region which has not yet been observed and additional experiments will be carried out in an effort to find this absorption.

Work on free radicals is continuing but at a somewhat reduced pace. The basic structure of many of the simplest radicals has been determined and the methods necessary to find others have been established. There remain a number of radicals which have escaped detection in spite of efforts to find them. It appears that better experimental techniques are required if this field is to advance and some effort is now being applied to find such techniques.

NEW ADVANCES IN ULTRA-HIGH VACUUM TECHNIQUES

As part of a program to develop and use ultrahigh vacuum, NRC has developed new techniques as well as new types of vacuum gauges which are now being manufactured in the U.S.A. and Germany. The use of these techniques has led to a re-examination of many important properties of ultraclean surfaces.

In 1956 it was decided that the Electron Physics Section of the Radio and Electrical Engineering Division would undertake a program of studies concerned with the properties of solid surfaces. Some reasons for this decision were: a) Advances in ultrahigh vacuum technology suggested that a major break-through in surface science was possible in the next decade. It appeared possible to answer many challenging scientific questions which it had not been possible to tackle previously for technical reasons. b) The research effort around the world devoted to surface science was small (compared to the enormous efforts in solid state physics, for example). It was hoped that a small research group with limited funds for equipment might be able to make significant advances in surface science whereas the same effort devoted to more fashionable studies (e.g., solid-state physics and solid-state electronic devices) would be at a disadvantage compared with larger and more lavishly funded research groups in other countries. Technical facilities for the design and construction of ultrahigh vacuum apparatus were established for the first time in Canada.

Ultrahigh vacuum technology was still rudimentary in 1956 and commercial equipment was not available. It was necessary to develop techniques of ultrahigh vacuum production and measurement suitable for the experimental study of solid surfaces. The NRC research program proceeded along two lines: 1) techniques for the achievement and measurement of ultrahigh vacuum were developed, 2) fundamental studies of phenomena occurring at very low pressures were carried out. These two lines were closely inter-related. From the first, a series of vacuum instruments were invented of which a few examples are given below. New types of cold-cathode ultrahigh vacuum gauges were developed which are now manufactured under licence in the U.S.A. and Germany. No Canadian firm expressed any interest in producing these gauges. Versions of this gauge have been used to measure atmospheric density at satellite altitudes, the first successful measurements were made from the U.S. satellite Explorer 17. Another version of this gauge will be left behind on the moon's surface to measure gas density in one of the early Apollo missions. A copy of a miniature mass-spectrometer developed at NRC has been flown in Russian satellites and used to analyse the constitution of the atmosphere. Several other pieces of ultrahigh vacuum instrumentation developed at NRC are now in use in laboratories around the world. These developments have resulted in international recognition of the NRC group as a leader in ultrahigh vacuum technology. The Physical Society of Japan reprinted a series of selected papers

in physics in 1967, the volume on "Physics and Technology in Ultra-high Vacuum" contained eleven papers, of which three were by staff members of NRC.

The second line of research indicated above has led to studies of surface properties which involved the interaction of low energy particles with solid surfaces and were directed towards a better understanding of the properties of solid surfaces. These investigations have included reflection and diffraction of very slow electrons from metals physical adsorption of gases on various solids, chemical adsorption of simple gases on metals, entrapment and penetration of positive ions into metal surfaces, interaction of slow electrons with adsorbed gas layers, and studies of thermal transpiration. These investigations have been carried out by a group of about 5 scientists (with appropriate technical support) and have resulted in some 60 scientific papers published since 1959.

Some of the major scientific advances resulting from this programme have been:

- a) Establishment of a universal relationship between the amount of gas adsorbed at low temperatures on a surface and the gas pressure over an extremely wide pressure range.
- b) The first experimental demonstration (in collaboration with AECL laboratories) of "channelling" of gas atoms in metal crystals. Gas atoms were observed to penetrate into a regular crystal lattice, in certain preferred directions, very much further than existing theories predicted.

c) It was demonstrated that the transfer of gas at low pressures across a temperature boundary in a tube was affected by the surface properties of the tube. This was in contradiction to generally accepted theory.

d) A theoretical model was developed to explain the observed interactions of slow electrons with adsorbed gas layers.

The scientific and technical data resulting from these studies in vacuum and surface science have been applied in many technical areas including a) simulation of extra-terrestrial conditions in the laboratory (space simulation), b) measurements from satellites and other space vehicles, c) development and manufacture of thin-film electronic devices, d) problems associated with plasma containment devices (intended for studies of controlled nuclear fusion), e) development and manufacture of new vacuum instrumentation, and f) catalytic processes.

OXIDANTS AND ANTIOXIDANTS

The gradual deterioration of rubber, plastics, lubricating oils, and edible fats and oils in use or in storage is largely due to reactions with oxygen from the air. A new theory of how this occurs has led directly to the discovery and manufacture of many new types of inhibitors. The annual production of antioxidants in Canada is a \$20 million business.

The reaction of organic compounds with oxygen from the air is one of the most important of all chemical processes. Familiar examples are respiration and combustion, but there are also a host of other reactions which stop short of the complete conversion of the organic material to carbon dioxide and water. Their beneficial effects are apparent in the synthesis of valuable chemicals (such as phenol and acetone) by the partial oxidation of relatively cheap hydrocarbons derived from petroleum. Their harmful effects are apparent in the development of rancidity in edible fats and oils, in sludge formation in lubricating oils, and in the slow deterioration of rubber and plastics. Some of these adverse reactions occur spontaneously during normal use or storage.

About fifteen years ago the Director of the Applied Chemistry Division initiated a study of ways to improve the performance of lubricating greases and oils, with particular emphasis on the prevention of spontaneous oxidation. It had been known that the harmful oxidation of an organic substance could be reduced by the addition of small concentrations of certain compounds known as antioxidants.

Up to that time, though, the additives used by industry had been discovered by purely empirical, or "cut-and-try" methods. The theoretical understanding of the fundamental mechanism by which these substances prevent oxidation lagged far behind, and as a result progress in this field was seriously hampered.

In several countries attempts were made to remedy this deficiency, though with little initial success. It is true that one promising theory (developed outside of Canada about 1956) was widely accepted for a while but it failed to survive the tests of time and experiment, though several years of work by many laboratories were required to disprove it. During and after this period one senior scientist at NRC devoted his time to evolving a new and different theory of the antioxidant action. His insight, coupled with a bit of luck, has led to a much clearer understanding of the basic chemistry involved. At least his theory, published in several papers during 1962-64, has successfully withstood all experimental checks made to date and, of even greater practical importance, has been directly responsible for the discovery and manufacture of many new types of industrial antioxidants. The economic value is appreciable: in Canada alone the 1966 production of antioxidants amounted to 3,000 tons, worth roughly around 20 million dollars. Industrial laboratories throughout the world now base their applied work in this field on the NRC theory.

Quite often the storehouse of fundamental scientific knowledge does contain just the right information needed to answer a specific industrial requirement but sometimes it does not. Then the initial impetus for a piece of basic research stems directly from the practical problem, as happened in this case. However, the course of basic research, even basic research stimulated in this fashion, is not nearly as predictable as that of applied research or development. It can happen that the results, if of any discernible practical use at all, may turn out to be a solution for a quite different problem, perhaps many years in the future. In the case of NRC's theoretical work on antioxidants a distinct element of luck was certainly present in the sense that the work happily turned out to be immediately applicable to the same industrial need that inspired the fundamental research.

CONTINUING RESEARCH PROGRAM ON FATIGUE OF MATERIALS

Fatigue failure is now the most serious problem in engineering design. Although particularly dramatic in aircraft, it is of tremendous economic significance in all moving or vibrating equipment. Since research is aimed at understanding and prevention, it is difficult to estimate the value of such research because it has to be evaluated in terms of the losses which did not occur because expert advice was available.

The fatigue failure of engineering materials is now the most widespread and intractable problem of engineering design. It is also of profound economic importance, as witness the fact that when a fleet of modern aircraft are required to be grounded and modified to remove a source of fatigue failure it has on occasion involved direct costs exceeding \$10 million; the fatigue failure of one class of railway Diesel engine has given rise to repair costs of about \$3 million; the market for a new product of otherwise impeccable design may be lost due to inadequate fatigue resistance. Research on the problem of metal fatigue has persisted for well over 100 years, and success is not even remotely in sight.

The phenomenon of fatigue in metals takes place under the influence of repeated load applications that are very much smaller in magnitude than the load that could be sustained by a metal were it applied only once. Under repeated loading, the atomic arrangement within the metal is progressively disordered until eventually minute cracks are formed. These cracks coalesce and propagate until

cracks are presently visible to the naked eye, and eventually the metal is totally fractured by instantaneous propagation of the grown crack.

The rate of fatigue failure is seriously affected by a large number of operational variables and notably by an even mildly corrosive environment. In fact, the water vapour in the air we breathe may halve the life of an aluminum alloy part as compared with its life in dry air.

A multi-pronged attack on the fatigue problem has existed in the National Research Council for more than 20 years, and there is unlikely to be any reduction in the effort applied within the foreseeable future. In the Division of Pure Physics, work is concentrated on the behaviour of the atomic lattice and sheds light on the way in which atomic disorder is produced; in the National Aeronautical Establishment, attention is focussed on the fatigue behaviour of aircraft materials and structures, and on the effect of operational variables; in the Division of Mechanical Engineering, work continues to investigate the very difficult problems of fatigue of machine elements such as gears, and shafts and bearings, turbine and compressor discs.

From all this work, and despite the absence of any over-all solution to the fatigue problem, there are valuable economic returns. This comes about because the National Research Council has acquired a nation-wide reputation for the quality of its expertise in the subject,

and many organizations have availed themselves of its assistance with critical fatigue problems. Solutions have been provided to eliminate fatigue problems in twelve different types of aircraft, in paper making machinery and road vehicles, in power generating equipment and transformers, and in building construction equipment and industrial machinery of many kinds.

The practical fatigue problem is of course inseparable from the problem of knowing the practical applied loading that engenders fatigue. To deal with the loads applied to aircraft by atmospheric turbulence, the National Research Council has made in-flight measurements on a global scale covering a total distance of $1\frac{1}{2}$ million miles. To deal with the loads applied to railway rolling stock, it has been necessary to measure the effective roughness of the road bed of Canadian railways to the extent of 70,000 miles.

The total financial benefit of the National Research Council's work on fatigue is substantial, though difficult to estimate. Certain individual projects, however, have had readily identifiable economic consequences. For instance, a fatigue project on a military aircraft was estimated to have saved the Canadian Air Force about \$3 million; and a similar project on a civil aircraft development was recorded by the Vice-President of the Company concerned as having rescued a foundering development costing \$2 million.

There is every indication that the industrial need for this kind of assistance from the National Research Council will continue unabated.

SPHERICAL AGGLOMERATION OF MATERIALS

A technique for the selective spherical agglomeration of particles in slurries has been discovered. Applications to ore upgrading, the separation of bitumen from tar sands, pelleting of materials, and many others are being tested.

This is a case history of a discovery so new that its potential has not yet been exploited.

Some years ago the Director of the Division of Applied Chemistry was intrigued by the fact that crystals of barium sulphate suspended in benzene formed spheres (agglomerated) when the suspension was shaken. He decided to seek the explanation of this unexpected result. In a relatively short time it was determined that the crystals were coated with a layer of water which acted as a binding material to hold the particles together when they touched.

The Director was impressed with the possible practical applications of this technique. Slurries (suspensions of insoluble particles in a liquid) are common in some industries. If the valuable particles in the slurry could be coated and agglomerated their recovery would be greatly facilitated. If a slurry contained several different valuable particles it might be possible to discover 'wetting' agents that would coat each of the valuable particles preferentially, and not the others, permitting the successive agglomeration and selective recovery of the valuable materials.

After preliminary tests, patent applications were filed on several potential uses and development work was begun. This has included such studies as the upgrading of ores, the separation of bitumen from tar sands, the preparation of dispersible pigments and the upgrading of coal for coking. Further works has led to methods of preparing spherical shot from a wide variety of materials from tungsten carbide to lead. A new process for making phosphoric acid is another direct result and the end of new application ideas is not yet in sight.

It generally takes about 15 years for a new process to become established in industry largely because a new process has to compete with old, established processes in which industry has a considerable capital investment. It is believed that as new industrial plants are built and old ones replaced this new process will gradually be adopted by industry.

PHYSICAL STANDARDS

The international standard of length is no longer a metal bar but the wavelength of light emitted from krypton. The international standard of time is no longer the earth's rotation period, but the period of atomic resonance of cesium. Technology based industries must be able to check their measurements against such standards regularly by an approved National Standards Laboratory in order to meet contractual specifications. NRC provides such a laboratory adapting new scientific knowledge to develop improved physical standards.

The day is past when the international standard of length was a metal bar housed in Sevres, France. Today the standard unit of length is based on the wavelength of light emitted by krypton gas. This permits a meter (approximately 3.28 feet) to be measured with an accuracy of 0.01 micrometers (about one two-millionth of an inch). Today the standard unit of time is no longer based on an astronomical observation but on the atomic resonance of Cesium and can be measured to an accuracy equivalent to one second in 16,000 years! It is important to realize that the development of standards to these accuracies is not merely a form of intellectual exercise; it is a development to meet important industrial needs. All advances in the physical sciences and technology are based on the ability to measure accurately, and the more advanced science and technology become the greater is the demand for more accurate measurements. But of even more direct economic importance, the modern technology-based industries have a working need for direct access to these same standards

and sophisticated methods of measurement. All this is widely recognised and explains why leading technological countries have established specialised, national "Standards Laboratories".

It is not only the new technological industries that require established standards of measurements. Agriculture and the food industry rely on precise light and colour standards in order to maintain the quality and uniformity of their products and to avoid financial losses that can arise from the uncertainty in grading their products by subjective methods. There are other important services (time services, nuclear and X-radiation protection, etc.) in which only scientifically defined standards can provide a reliable reference or safeguard. Indeed it can be asserted that it was only the establishment of reliable radiation measurement standards that made possible the determining of safe dosages for radiation therapy and diagnosis to which thousands of persons are exposed daily. And the scales in retail outlets still need periodic checking to ensure that they give honest weight; a relatively crude application of standards but one that reaches into the daily life of every citizen.

Between the two World Wars the National Research Council was made responsible for the "Investigation and determination of standards and methods of measurements". This was a somewhat incidental responsibility as the requirements were not excessive. During World War II there was a tremendous expansion of industry and science in Canada. The Director of the Division of Applied Physics

realised that continued technological growth would require the services of a first-class Standards Laboratory. To meet this need in a way that promised to combine the best scientific capability with a reasonable level of expense, the Director decided not to press for a separate Standards Laboratory but to incorporate the work on standards within the framework of the already existing Division. This had another advantage. Experience in other countries showed that the establishment of a Standards Laboratory without a strong research component substantially degraded the levels of the available reference standards and calibrations; incorporation within an existing research Division would provide the desired research climate.

Over a period of years, measurement standards in all fields were established, but research was concentrated on selected areas that seemed to promise a high return for relatively modest outlays in manpower and money. This approach proved to be a sound one. Canada's outstanding contribution is recognised by all major national standards laboratories in virtually every standards field. Accuracy and precision of measurement in the NRC laboratory are comparable with, or even exceed, those produced in laboratories in other countries, and in many instances, Canadian basic standards have been among those from two or three laboratories used to derive the world standards. As a result NRC scientists have been invested with international responsibilities of the highest order in these fields, as, for example, the presidency of the prestigious International

Committee of Weights and Measures.

Domestically, the NRC work in standards provides a highly sophisticated scientific service to industry, commerce and science in Canada. The value of this derives not only from the rapidly growing automation and complexity of modern manufacturing processes, but also from the fact that domestic and foreign markets insist on uniformity and increased quality of products. For example, the Defence Production Sharing Agreement between the United States and Canada embodies a U.S. requirement that all measuring and testing equipment used in Canada, in manufacturing annually about \$200,000,000 worth of military equipment for the U.S.A., must be calibrated at an approved national standards laboratory.

It can be stated that the resources used to establish Canada's primary physical standards and calibration services have resulted in economic and scientific returns which are very substantial in relation to their costs; furthermore, it seems certain that these returns will continue to increase as Canada continues her technological advancement.

ETHYLENE OXIDE PRODUCTION PROCESS

An improved catalyst was developed for use in the manufacture of ethylene glycol (anti-freeze). The advantages did not turn out, however, to be great enough to displace existing catalysts from existing plants. It was a technical success, but an innovational failure.

In the late thirties, work was in progress in the Division of Chemistry on the production of ethylene oxide by the catalytic oxidation of ethylene. Interest in this chemical was stimulated by the fact that ethylene glycol antifreeze which is made from ethylene oxide, was required in the war effort, but was not being manufactured in Canada at that time. As a result of an experimental study, the Division of Applied Chemistry developed a new silver catalyst which appeared to be superior to other catalysts then available. It was made by leaching calcium from a calcium silver alloy to yield a porous active catalyst having long life if precautions were taken to avoid chemical poisoning, and having very good thermal conducting properties. This latter property is vital in maintaining the close catalyst temperature control required to maximize the yield of intermediate product of ethylene oxide rather than the complete combustion of ethylene to the end products of carbon dioxide and water. In this period, experimental work was at the laboratory scale, and involved normal resources approved by the Director within the Division. Attempts were made

during this period too, to interest industry in Canada in the Cambron process, by providing bench scale reactors for testing on feed stocks in their plants.

After several unsuccessful attempts to get industry in Canada to develop the process, Canadian Patents and Development Limited, who had undertaken commercial promotion on behalf of NRC, licensed the catalyst and process in 1950 to Stone and Webster Engineering Corp., Boston, with the understanding that this firm would design, sell and build plants anywhere in the world. Stone and Webster produced at least two serious customers. Firestone Rubber of Akron, Ohio, built a pilot plant and assessed the catalyst in 1952-53. During the year the pilot plant operated, the price of ethylene oxide declined from \$0.17 to \$0.14 per pound, which made the established performance by the catalyst marginal, and this company lost interest. Further pilot testing was then authorized by NRC management in Ottawa on new proposed reactor designs with the object of improving catalyst of performance. In 1957, another testing program was arranged by Stone and Webster Corp. with Allied Chemical Co. Ltd. in their plant at Orange, Texas. The assessment by this

company was again that the Cambron catalyst, although comparable with a commercial catalyst in use in a competitive process could not displace the established catalyst from an operating plant.

Following these tests, activity in the Division on this project reduced to a minor level by 1962. This action was due to the recommendation of an NRC Review Committee, and to a recognition by the Director and Section Heads involved that Divisional resources could be applied more profitably on other projects, though several industrialists have stated that a reasonable percentage improvement in the selectivity-yield pattern could make them very interested even yet in the Cambron catalyst.

This case history illustrates the fact that an improved process or product has to be competitive at the time it approaches commercial use if it is to be used. This is frequently many years - even decades - subsequent to the initiation of the research and development program. During this period the market situation may change significantly. Thus, the would-be innovator always has a triple problem - is the improvement likely to be possible technically, how long will it take, and what developments will have occurred in the marketplace during that time.

PRECISION POTENTIOMETERS

A new basic idea led to the invention of a new line of superior potentiometers. Guildline Instruments Co. have taken a license and have started manufacture. Production is estimated at \$500,000 next year.

The Division of Applied Physics has for many years carried on research to improve the accuracy and stability of precision potentiometers and their inventions have resulted in the world's finest instruments of this type. A small Canadian company has produced these and established an international reputation for their products.

In 1958, the Radio and Electrical Engineering Division assumed responsibility for Canadian participation in international standardization work on precision current transformers. A study of the problem led to the conclusion that if significant improvements in accuracy of calibration were to be achieved, a new approach would be needed, and this led to the development of the current comparator, a device in which currents are compared in terms of their magnetic effects on a magnetic core. This comparator in itself represented a considerable advance in the state of the art, and enabled the Division to more effectively carry out its responsibilities in the calibration of current and voltage transformers for industry and for the Department of Trade and Commerce.

It soon became apparent to the inventors that the basic principle could be applied to a DC comparator, and from there the idea developed that potentiometers and a range of other instruments could be produced that might be useful. A model was built, and on test proved to be superior to the best existing instrument. The result was discussed with the licensee who produced the current comparators and the existing high precision potentiometers, and his enthusiasm and estimate of the commercial value of the work resulted in the decision to carry on to develop a range of instruments all based on the current comparator principle. These had a degree of linearity which was fifty times better than the best existing instruments.

Guildline Instruments have now taken a license on the various inventions, and have won two awards in an international competition held to select the one hundred most important technical developments in the field of electronic instrumentation and components. The company is presently doubling the size of their plant mainly to take care of the increase in business founded on the new instruments which is estimated to amount to \$500,000 in the next year.

This project originated internally as an off-shoot of another program in a laboratory that would not normally be concerned with high precision instruments of this type. Alertness of the inventors and prompt assessment by industry resulted in a range of new instruments that are considered to be a significant breakthrough in the science of precise electrical measurement.

This case history illustrates several points, but particularly that a program or project devoted to meeting one specific need may often develop a solution which opens up other possibilities too, and is much more broadly useful than just filling the original need.

DEVELOPMENT OF RAPESEED AS A CROP IN CANADA

A newly developed strain of rapeseed has enabled Canada to change from a net importer to a net exporter of edible vegetable oils. About 1.5 million acres are devoted to rapeseed production providing a \$50 million per year cash return to the farmer. This represents a significant contribution to reducing the problem of wheat surpluses with economic advantage.

Rapeseed was introduced into Canada in 1942 to supply a wartime emergency need for steam engine lubricants. After preliminary trials, the Forage Crops Division of Canada Department of Agriculture selected Black Argentine rape as best suited to Canadian growing conditions. During the war years, production was under the control of C.D.A., and chemical analysis and quality control was monitored by the NRC Prairie Regional Laboratory on the University of Saskatchewan campus.

At the end of the war, in evaluating the program it appeared that the market for steam engine lubricants would decrease since there was a definite trend to increasing use of diesel engines on our railways, in our ships, and in industry. Estimates showed that requirements for this oil in Canada could be met by seed from not more than 3,000 acres. It was obvious that if a continuing substantial market were to be found for rapeseed oil, it would have to be in the edible oil industry.

In assessing the possible success of a program aimed at this objective, the following factors were considered favourable:

1) In a national emergency Canada had found herself seriously deficient in edible oil supplies, and this could happen again;

2) a domestic vegetable oil crop would help to diversify the wheat economy of western Canada;

3) rapeseed had proven well adapted to growth in the more northerly areas that traditionally produced low protein wheat;

4) rapeseed could be grown and harvested with conventional farm equipment;

5) Canadian farmers had become familiar with the production of rapeseed, and

6) rapeseed was well established as an edible oil crop in Asia and had been the sole edible oil supply of the German economy during the war.

Factors unfavorable to the venture included:

1) rapeseed oil was regarded in developed countries as an industrial oil of inferior quality for edible use;

2) no domestic oil processing industry would consider a new raw material unless they were assured of a continuing supply;

3) producers would not grow a crop unless a market existed;

4) development of early varieties having uniform maturity and high yield was incomplete, and

5) rapeseed meal contained goitrogenic (goitre-producing) factors which limited its use as an animal feed.

A closer study of these unfavorable factors revealed that in the immediate post-war period there was a substantial export market for rapeseed to supply edible oil to war ravaged countries of Europe. This was developed by the J. Gordon Ross Syndicate financed by private grain traders. Most of the seed was sold through the Marshall Aid Plan and some oil was sold to the U. S. government stockpile of strategic materials. In view of this there appeared to be a real possibility of developing a sufficient volume of production to interest domestic oil processors. Consequently, the decision was taken by NRC's Prairie Regional Laboratory (PRL) and the Canada Department of Agriculture (CDA) to continue work on development of new improved strains of rapeseed.

This effort was successful and led to the release of high quality seed that produced a good quality oil. This resulted in the growth of production and export of seed to the point where oil processors in Canada could see the real possibility of a continuing supply. At this stage Canada Packers became interested in the possibility of using rapeseed oil in the production of domestic margarines and shortenings.

Through cooperative work involving plant breeders in Canada Department of Agriculture, chemists in the Prairie Regional Laboratory and grain traders, operational answers had been developed to all the major unfavorable factors limiting the programme, except the crucial problems of acceptance of rapeseed oil by domestic oil

processors and consumers. At this point the Food and Drug Directorate began to express reservations on the use of erucic acid oils (a constituent of normal rapeseed) in human diets. This was due to the fact that very little nutritional work on rapeseed oil had been done in the U. S., Canada or Britain and the results reported in the scientific literature were contradictory. However, as a result of discussions of the problem, officials of the Directorate agreed to cooperate with scientists at the Prairie Regional Laboratory in research projects to investigate the nutritional value of rapeseed oil. At the same time work aimed at development of rapeseed varieties free of erucic acid was undertaken in collaboration with plant breeders in the Canada Department of Agriculture and western Canadian universities.

Using information obtained in fundamental research at NRC's Prairie Regional Laboratory, rapid analytical techniques for determining the fatty acid composition of the oil from a single rapeseed were developed. The initial application of these techniques disclosed that with self-pollinated rapeseed plants perhaps one seed in 200-300 actually was totally free of any erucic acid content. With further refinement of the analytical technique it was possible to analyse one half of a single seed, and when one with no erucic acid was identified, to grow a complete plant from the other half of the

seed containing the germ. Having isolated the germ plasm from a rapeseed plant containing no erucic acid, it was then possible by conventional plant breeding methods plus the new analytical techniques, to produce new varieties having the other desirable characteristics of high yield, high oil content, and early maturity.

In the early stages of the project all of this critical analytical work was done in the NRC Prairie Regional Laboratory. As the work load increased and it became evident that technical success was clearly attainable, the Canada Department of Agriculture laboratory in Saskatoon purchased equipment to do the chemical analyses. During this period the Prairie Regional Laboratory trained technicians for the Canada Department of Agriculture and supplied check analyses and maintenance for their equipment.

When larger quantities of seed began to be produced oil samples were extracted at NRC's Prairie Regional Laboratory and sent to Canada Packers' laboratory in Toronto for commercial evaluation. Samples were then sent to the laboratories of the Food and Drug Directorate for nutritional tests. In this program analytical work on the oils and the fats of test animals was done at NRC's Prairie Regional Laboratory.

In a parallel project carried on at the same time in NRC's Prairie Regional Laboratory on normal rapeseed oil containing erucic acid it was proved that this acid is produced in the

rape plant from oleic acid, and in the metabolism of the test animals it is broken down again to oleic acid. Since oleic acid is a normal constituent of all animal fats, it was evident that erucic acid as such behaved in a perfectly normal manner in nutrition. Furthermore, in collaborative research studies it was shown that the conflicting results which had been reported in previous studies were really due to the low content of saturated fatty acids in rape oil. When the rape oil was combined with additional small amounts of these saturated acids the apparent deleterious nutritional effects vanished. These results had a major effect on clearing the way for use of rapeseed oil in food products in Canada.

Since both the Food and Drug Directorate and Canada Packers had participated in the research program no convincing was needed and no difficulties were encountered in transferring the results into commercial technology. A small discount in price below that of soya oil, induced processors to begin using rapeseed oil in shortenings and margarines.

In this operation it was found that some of the sulphur components from the goitrogenic factors in rapeseed were extracted with the oil and these tended to spoil the catalysts used in the oil hardening process. Some fundamental research soon traced this effect to an enzyme present in the seed. Further laboratory studies revealed that this enzyme could be inactivated prior to extraction of the oil by controlling moisture and temperature levels

to specific levels in processing. Collaborative work with personnel of the Saskatchewan Wheat Pool on a commercial scale plant resulted in the successful application of this information in commercial oil extraction.

As a result of this overall program rapeseed oil is now being used to supply 25% of the vegetable oil requirements in the manufacture of margarine and shortening in Canada. There has been a steady increase in domestic use and the seed is gaining increasing acceptance in the export market.

Some problems are still being encountered in using the by-product rapeseed meal residue in livestock feeding due to the sulphur containing goitrogens which are left behind in the meal. As a result of studies sponsored by the National Research Council's Associate Committee on Animal Nutrition acceptable levels for incorporation in livestock feeds have been defined. The meal is being used but is selling at a discount of approximately \$10.00 per ton protein basis below soya meal. Chemical treatments to destroy the goitrogens have not been too successful. Consequently, a program is now underway to eliminate these undesirable components through breeding and selection, and the development of new varieties. Following the pattern of the previous program on the oil this project involving collaborative work, with personnel in CDA doing plant breeding, nutritionists in CDA and the universities performing

nutritional studies and NRC Prairie Research Laboratory workers doing the biochemical and analytical work.

Suitable breeding stocks have already been established and it is simply a matter of time and effort till the necessary improved varieties are developed. This will be of major importance in expanding markets for Canadian rapeseed. Currently Japan is our major export customer for rapeseed. However, they are using the rapeseed meal as fertilizer. If they can be induced to use the meal in feeding of swine and poultry, this should greatly improve the competitive position of rapeseed in this market.

This program has resulted in an average of 1.5 million acres devoted to rapeseed production in each of the last three years, and has provided roughly 50 million dollars a year in cash returns to Canadian farmers. If it is assumed that the land would have been sown to wheat if rapeseed had not been grown this is equivalent to an average net decrease in wheat production of 30 million bushels per year. In view of the potential increase in domestic consumption and export it appears that the program represents a significant contribution to reducing the problem of wheat surpluses with economic advantage.

A major contribution has been made to supplying Canadian edible oil requirements from domestic production. This combined with earnings from export of seed means that

Canada has moved from a major net importer of vegetable oils to a net exporter.

The fundamental research that provided the driving force behind this program was done in NRC's Prairie Regional Laboratory. When sufficient information was available applied research was initiated within the laboratory and where personnel and equipment were not available within the organization, active collaboration was sought with personnel in other organizations.

This program illustrates a number of points, some of the important ones of which are:

1) Innovations of really major economic importance often take several decades of patient continuing work before the big economic returns really begin.

2) The money spent in the research and development period is always small compared to the economic return if the project is a success at all.

3) Ultimate economic success is contingent on there being one or more dedicated individuals who never give up, through the decades in pursuit of their vision.

4) A successful R & D program is rarely ever finished. Its very success usually demands further work directed to maintaining and increasing the success. Usually only failures ever have a clear-cut end which can be identified for accounting purposes.

INNOVATIONS IN MILITARY AND
GEOPHYSICAL AIRBORNE MAGNETOMETRY

A new airborne magnetometer system with radically improved resolution has been developed. Not only has this improved the detection range of submarines, but also the detection of magnetic variations on the Continental Shelf. These variations indicate possible oil-bearing areas. Canadian Aviation Electronics has a sales volume of \$9 million per year currently from these instruments.

This work has been chosen for discussion primarily because it is an excellent example of a program of work that is both interdisciplinary and interdepartmental, that has enjoyed substantial economic and scientific returns on the investment, and that has been consistently successful for many years.

Magnetometry is the measurement of the strength of the magnetic field effects produced by a magnet or by any physical system possessing distinct magnetic properties. Examples of such systems having important military or economic significance are mineral deposits in the earth's crust, submarines, sedimentary rock structures indicating oil deposits, and ocean wave motion. One particular objective of the National Research Council's work has been the development of airborne magnetometry techniques that can reveal geological features which cannot be observed on conventional aeromagnetic survey maps.

Although the original impetus for the program was national defence submarine detection, it has always been appreciated that equipment and techniques developed during the research program had potential

application in many non-military areas of endeavour, and these have been exploited wherever possible.

As an example of one interesting project of dual nature, we consider the problem of magnetic field variations due to the geologic structure of the Continental Shelves adjacent to the Canadian coastline. These magnetic field variations behave as background noise tending to camouflage the magnetic signature that a submarine impresses on the local magnetic field, and for this reason their characteristics must be measured and taken into account. On the other hand, the magnetic variations themselves, that are merely a nuisance from the point of view of submarine detection, offer evidence of the geologic structure of the Continental Shelves and, when properly interpreted, of the possible oil-bearing potential. For this reason, high resolution magnetic measurements over the Continental Shelves were planned and executed with the active cooperation of both National Defence and the Department of Energy, Mines and Resources.

The primary technical problem to which the National Aeronautical Establishment has addressed itself has been the development of an airborne magnetometer system capable of providing a resolution at least 100 times better than that available in 1960 when the project was started. To provide a perspective, a typical measured value of the earth's magnetic field is 60,000 gamma (where gamma is a unit of field strength). The ultimate objective of the program was to arrive at an airborne system capable of detecting a change of about 0.001 gamma, or approximately a one hundred millionth of the earth's field strength.

Up to about 1962, nearly all geophysical mapping magnetometers possessed sensitivities of between 1 and 10 gamma, and the first significant advance was made by the National Aeronautical Establishment in that year when it converted a military fluxgate magnetometer to airborne survey use and achieved a resolution of about 0.1 gamma. Subsequently, by adapting an optically pumped magnetometer, the theory of which will not be discussed here, the National Aeronautical Establishment achieved a practical system working to a resolution of 0.01 gamma. By the application of advanced principles of compensation procedure, the refinement of signal processing equipment, and from a knowledge of the sources of magnetic background noise due to geological sources and temporal variations in the earth's magnetic field, the objective of 0.001 gamma sensitivity is in sight.

In all this work a number of contributory projects were completed and a substantial volume of industrial production was put in hand, notably by Canadian Aviation Electronics who already ascribe about \$9,000,000 worth of sales to products originating with the NAE Magnetometry project. Based on the fact that CAE have achieved world leadership in the development and production of compensating devices, it has been estimated that this sales volume will be at least doubled in the next few years.

In addition to its commercially important developments in compensation devices, the NAE has reached commercially valuable end-points with its Orienting Rubidium magnetometer, with a readout

or frequency-to-voltage converter, and with a submarine anomaly simulator. These three devices are all the subject of patent action, and all three are in the pre-production phase in the Canadian Aviation Electronics Company. The sales potential for all three of these devices is excellent.

The development of magnetometer systems and system elements has, of course, involved a substantial amount of test flying in addition to flights designed to provide basic information on the nature of the environment in which magnetic signals have to be detected. The results of these trials have had immediate applicability to system development, but almost invariably some of these have been usable as the raw material for the creation of magnetic survey maps, and our colleagues in the Department of Energy, Mines and Resources have so used them.

Flight trials having the nature of high resolution aeromagnetic surveys have been conducted in the following areas:

The Mid-Labrador Sea Ridge

The Grand Banks and Flemish Cap off Newfoundland

The Labrador Sea

Across the Reykjanes Ridge Southwest of Iceland

The Hudson Bay

The Davis Strait and Baffin Bay

It has been established that the high resolution magnetometer is capable of detecting changes in the structure and composition

of the sediments within which oil is found, and the potential value of the surveys already made by NAE is very great indeed.

During all this work the submarine detection problem has never been lost sight of, and in fact it has now been shown by flight trials that, at the point of magnetometer system development now reached by NAE, the magnetic detection range of Canadian ASW aircraft can be doubled.

Two very interesting scientific by-products have also evolved from this work. The first came from the measurements across the Reykjanes Ridge and provided some new evidence on the history of the earth's magnetic field reversals during a period of about 60 million years. The second served to demonstrate the possible usefulness of airborne magnetometry as a remote measuring procedure for ocean wave spectra in deep water, and particularly for waves of relatively long period and very small amplitude. The total cost of this work over a period of about 8 years is approximately \$2,000,000, of which about one half has been provided by NRC and the other half by National Defence, DRB and DEMR. If one ignores entirely the military and scientific value of the work, a conservative estimate of industrial sales resulting from the work amounts to a total of \$20,000,000 by 1973.

The organizations participating in this work under the leadership of the NAE are as follows:

Government

National Aeronautical Establishment

Defence Research Board

Department of National Defence

Department of Energy, Mines and Resources

Industry

Canadian Aviation Electronics

Canadair

DeHavilland

Fairey Aviation

Computing Devices of Canada

Assistance has also been received from the Department of Defence Production and the Department of Industry in relation to industrial and commercial elements of the program.

AERODYNAMIC DEVELOPMENT OF CANADIAN AIRCRAFT

The low speed wind tunnel has been responsible for the aerodynamic development of twenty Canadian built aircraft types, with a total contracted value of \$2 billion.

Wind tunnels are the essential working tools for any kind of aerodynamic investigation, whether it be an entirely fundamental study of aerodynamic principles, or an empirical study of the characteristics of a new aircraft design. However, the kind of wind tunnel acquired for industrial development purposes is distinguished from others by the fact that it is very much larger, very well instrumented (including on-line data reduction computer), very well supplied with auxiliary services such as compressed air and variable frequency electrical power, and generally very expensive. The cost of models in this context is typically \$50,000, although a large, powered V/STOL model may cost \$100,000, and the extent of the experimental program will currently often involve occupancy of a wind tunnel for about 2,000 working hours.

In these circumstances, it has been the policy of the Canadian government to concentrate all its national resources of development wind tunnels in the National Research Council, and this has proved to be technically and economically an excellent solution to a complicated problem.

Up to the present time, in the low speed regime, one wind tunnel has been responsible for the aerodynamic development of the following Canadian-built aircraft:

<u>Company</u>	<u>Aircraft</u>	<u>Approx. Number</u>	<u>Company</u>	<u>Aircraft</u>	<u>Approx. Number</u>
<u>DeHavilland</u>	Chipmunk Trainer	60	<u>Canadair</u>	C-4 Transport	50
	Beaver Utility	1800		C-5 Transport	1
	Otter Utility	500		CL-28 Argus	24
	Caribou Transport	200		CL-41 Tutor	190
	Twin Otter Transport	200		CL-44 Yukon	20
	Buffalo Transport	20		CL-84 V/STOL	4
<u>Avro</u>	CF-100 Fighter	750	<u>Fairchild</u>	CL-89 Drone	?
	C-102 Jetliner	1		CL-215 Waterbomber	30
	CF-103 Fighter	0		Husky Utility	15
	CF-105 Fighter/Bomber	3			
			<u>Noorduyn</u>	Norseman Utility	300

This list covers a period of about 20 years of work in the low speed wind tunnel, and the total value of contracts relative to these aircraft amounts to about \$2 billion, of which about \$200 million are from export sales. It is to be noted that the list does not include mention of the T-33, F-86, CF-104 and other aircraft that were manufactured in considerable numbers in Canada under license and for this reason not developed in the wind tunnels of N. R. C.

The capital value of the wind tunnel in which the work was done is estimated at \$2½ million in current dollars, and the total annual operating costs are estimated at \$200,000. If it is assumed that the benefit of this program may be identified with the dollar contribution to the GNP that has resulted, the cost/benefit ratio turns out to be about 0.3%.

There are, moreover, a considerable number of valuable by-products. For instance, it is known that Canadian aircraft production has a very considerable influence on foreign sales of

aircraft equipment and components, and to put this point in perspective it should be noted that the Canadian aviation industry as a whole (including the air transport industry) is now contributing about \$1 billion per year to the Gross National Product, of which approximately \$200 million per annum derives from export sales of aircraft, engines and parts. It should also be noted that the ratio of aircraft industry exports to total production is over 50%, which is five times the ratio for United States exports.

The dependence of the Canadian aircraft industry on foreign markets requires a foreign acceptance of the credibility of the scientific support available to Canadian manufacturers, and this credibility is substantially dependent on the existence of first quality wind tunnels and supporting staff.

Another by-product of the aerodynamic work of the National Aeronautical Establishment is related to the fact that foreign government aviation laboratories have always published substantially in report series only available from the laboratories. These report series are of inestimable value to our manufacturers and Universities but they are often available only on the basis of reciprocity. It is a fact of the Canadian scene that the flow of foreign research material into Canada has been maintained as an act of reciprocity for a much smaller flow of similar material from the National Research Council into other countries.

The existence of development wind tunnels in the National Aeronautical Establishment has provided tools for the research staff,

and also for University staff who in recent years have been making increased use of National Research Council wind tunnels. This form of cooperation has had the effect of improving the alignment and coordination of aerodynamic research among industrial, Government and University research groups.

IMPROVEMENT OF MACHINE TOOL TECHNIQUES AND PRODUCTIVITY

The most modern machine tools often needed for special orders are frequently difficult to justify as investments for a Canadian manufacturer. NRC has taken several steps to make available advice and help in such situations.

A common way in which the issue of improved productivity presents itself is the opportunity to a company to tender on a contract which involves a purchase of expensive new equipment, which is difficult to bring into successful operation. When a company decides on investment in new equipment, it faces the dilemma of a rapid write-off of the investment, with the risk of pricing itself out of the competition, or, alternatively, if it chooses a reasonable overhead on the work, it is left with the hazard of amortizing the residue of its investment against an as yet unestablished market.

With the realization that it is frequently difficult for small and medium sized Canadian manufacturers to shop on a sufficiently wide and discriminating basis, and that it is even more difficult to muster new technical skills to achieve improved productivity against a short term deadline, the National Research Council has established a capacity which can be used by Canadian industry.

A particular instance arose from a necessity to modernize a jig boring mill which was 35 years old and gradually losing its accuracy. Rather than buy a new machine for some \$80,000, the existing machine was sent to a Canadian firm for re-scraping and re-fitting all the slides (for a price of about \$4,000), a job which was done with tolerances within one-half of the limits allowable by the manufacturer on a new machine. The Council also took the opportunity to fit for an additional price of about \$10,000 the most modern and precise type of digital read-out system, which had to that point entirely failed to make a single sale in Canada. Within 18 months, as a result of the exhibit of this machine at one of the Toronto Trade Fairs, a million dollars worth of the new equipment had been sold in Canada.

On another occasion the issue was more severe. This country constructed in Lachine (as one of its NATO undertakings, we understand) one of the best shops in the world for the heat treating and precision grinding of gearing. In the course of events, the intermittent work allowed the skill to deteriorate and the interests of the managing company and of the government diverged to the point where it was decided to close down the shop and sell the machinery. The Department of Defence Production turned over to the National Research Council the two best machines in response to an undertaking that the National Research Council would bring the machines and the

supporting personnel to the highest standard obtainable, that the NRC would perform emergency regrinding of destroyer escort reduction gearing (which any responsible country would require as a necessity to be able to do within its own borders and its own control), and that the National Research Council would make the equipment available to Canadian industry unable to maintain this standard of equipment in continuously profitable employment. Within one month of the time the first machine had been brought into operation, an emergency request was received from a company manufacturing locomotives for export to refinish a set of transmission gearing for a locomotive for which all the shipping arrangements had been made. By working 24 hours a day for 3 weeks, we were able to put the work right, but, more happily, we were also able to assist the company who had made the defective gearing to improve their technique in a sufficiently economical way to allow them to proceed with the subsequent work. In this connection, it needs to be remarked that the shipping of locomotives is a specialized business because of the great concentrated weight, and that it requires the scheduling of ships with specially strengthened decks and very high capacity floating cranes at both shipping and receiving ports. The upset of a schedule of this kind is a serious business.

The next step now being taken pertains to the numerical

control of machine tools, an aspect of manufacturing where we find from the Department of Industry a substantial need of technical support throughout Canada.

Through the joint associations with the British Columbia Research Council and the Department of Industry, we have become aware of the desirability of economics in the cutting of lumber and various other materials, including fabrics and leather, and have put in hand an experimental program relating to the cutting of materials by very high pressure water jets, the success or failure of which remains to be seen.

VASCULAR SUTURING INSTRUMENT

A group of surgical instruments has been developed to enable surgeons to join blood vessels with tantalum staples. Commercial instruments should be ready for production shortly.

This group of surgical instruments has been developed to enable surgeons to join blood vessels, ureters, etc., by means of tantalum staples. Joints can be made in vessels ranging from 1mm diameter up to 12mm diameter much more rapidly than by hand suturing, and the smaller sizes could not be done by hand.

The project originated when two Ottawa surgeons approached NRC to get help in devising an instrument to staple arteries. They knew the result they wanted, but not how to devise the means. The Division of Mechanical Engineering undertook to investigate the problem and an instrument was designed and built. This was assessed and found promising enough to warrant further work and a new series of improved instruments was designed and built by a larger group.

Clinical trials were required to assess the instrument's performance and a group of instruments was made in NRC workshops. At the same time, CPDL who had filed patent applications was trying to interest industry in producing instruments. As an incentive to industry, and to provide more test instruments, CPDL placed orders for sets of instruments with two Canadian companies. NRC tested and

evaluated the products and the acceptable instruments were loaned to surgeons in various countries for trial. Selection of surgeons was made by the Medical Research Council.

Early results indicated that problems of cleaning, loading and sterilizing the staple bushings would prevent widespread use unless a cheap disposable bushing could be provided.

The two original licensees dropped out but a third company was persuaded to take up development of commercial instruments and plastic disposable staple and anvil bushings. CPDL financed much of this through development contracts while NRC continued to work on new instruments to enlarge the size range and provide a few of these instruments for trials.

Disposable plastic staple and anvil bushings have now been completed and commercial instruments should be ready for production shortly. Canada now has made an important contribution to surgery and has the start of a surgical instrument industry. The experimental instruments have been used for emergency and transplant use on humans with excellent results. We now have knowledge of some 20 local cases of their use in clinical surgery. In roughly 50 per cent of these use of the instrument is credited with saving a life or a limb.

BRAIN COOLING FOR SURGERY

Equipment has been developed enabling the human brain to be selectively cooled to near the freezing point, which makes possible new brain surgery procedures.

In February 1963, an Ottawa surgeon suggested to the Director of the Division of Mechanical Engineering that, if a means could be devised to cool the human brain without cooling the rest of the body, surgical procedures could be undertaken that would otherwise be impossible. The surgeon's suggestion was that a heat exchanger be inserted in the arterial circuit to the brain and that the problems of a mechanical pump be eliminated by using the heart as a pump to overcome the flow resistance of the heat exchanger.

The Director decided to have the Low Temperature Laboratory appraise the feasibility of the proposal before making any commitment. Since the body was to remain warm and the brain was to be cooled to a temperature approaching the freezing point, a high efficiency heat exchanger was required. At the same time, it would be necessary for the exchanger to avoid lowering the pressure or flow of blood to the brain, at least in the initial cooling phase, or else serious brain damage might result. Unfortunately these are divergent technical

requirements as normally a highly efficient heat exchanger slows down the flow. Nevertheless other factors led the researchers of the Low Temperature Laboratory to the conclusion that there was a reasonably good chance to solve the problem and the Director decided to permit them to undertake the project. In March 1963, it was agreed that the Low Temperature Laboratory would proceed to develop an experimental prototype of the heat exchanger with the Division bearing the cost and the surgeon would undertake the medical and surgical work supported, in part, by a grant from the Medical Research Council.

By May 1963 the mechanical design of the heat exchanger was completed and by July the prototype unit was ready. In August the first experimental application of the heat exchanger was made on an animal. A variety of engineering and medical problems became immediately apparent. To solve these a combined medical-engineering team conducted several hundred procedures in experimental surgery during an evaluation and development program that extended over five years.

By August 1965 the feasibility of the overall concept was firmly established although various secondary problems persisted. An animal's brain could be cooled to 3°C , the blood flow stopped completely for an hour and the animal recover without brain damage.

In early 1966, the surgeon decided that the equipment and the surgical procedures had reached a point to justify their clinical use on patients classified as terminal. One such patient was suffering

from a malignant brain tumour in an extremely difficult location. As a result of this tumour his I. Q. had deteriorated to less than 80. A combined surgical-medical-nursing-engineering-technician team of 20 people was involved in an operation extending over 14 hours. The "terminal" patient is alive at the present time and his I. Q. returned to normal within a month of the operation.

It is difficult to place a dollar value on this work because the number of patients who might benefit from such drastic surgical procedures is not known and also because society normally avoids placing a dollar value on human life.

This report would end here if it were not for "spin-off" or "fall-out". These are jargon words that have come into use in recent years to designate the secondary application of knowledge derived from a primary study, an application that was not planned or envisaged originally. In this case the "spin-off", arising from the enterprise of the surgeon may well have more widespread use and prove more valuable than the original project.

The flexible tubing of the heat exchanger is joined to the arteries by connectors called cannulae. It was anticipated that commercially available cannulae would be used but they proved to have high friction losses, poor hydrodynamic design and high turbulence. Light weight, low turbulence cannulae with mirror finish surfaces were therefore designed and developed.

As a result of the development of these cannulae and of a new surgical procedure evolved during the experimental work, a new surgical method of dealing with certain types of 'stroke' cases was evolved. Partial blockage of one of the carotid arteries leading to the brain, frequently caused by the deposition of cholesterol on the wall of the artery, can result in a 'stroke'. Various surgical procedures have been developed to deal with these arterial blockages most of them involving cutting off the blood supply to the brain for hazardous periods, often resulting in crippling brain damage. Two local surgeons have employed a technique using the NRC equipment in such a way as to reduce the hazard greatly. The results from this operation have been so consistently satisfactory that surgeons in two other centres have asked for the equipment to enable them to take up this procedure. The apparatus is being put into commercial production.

To date, over twenty-five people have had their life expectancy increased as a direct result of this research project.

DEVELOPMENT OF AN AIRBORNE FLIGHT SIMULATOR

In order to investigate the flying qualities of new types of aircraft, flying "simulators" have been developed. These are helicopters equipped with extra thrusters and controls under the management of an electronic computer. The pilot flies "the computer", and the computer makes the helicopter behave with the characteristics of the aircraft being simulated. These simulators have made a major contribution to the design of aircraft in Canada.

It has always been required of an aircraft that, when it is disturbed in its motion by an external input such as a gust, or by an internal input such as a transient movement of the controls, it should return to its original flying condition readily and more or less automatically. This is regarded as a manifestation of the basic stability of the aircraft. It has also been required that the response of an aircraft to the manipulation of its controls shall be unambiguous, precise, and not excessively demanding of pilot capability. To the extent that this behaviour is achieved, an aircraft is regarded as having good control characteristics.

Stability and control are therefore regarded as subjects of fundamental concern in the design and development of any new aircraft.

With the advent of high performance aircraft, and special duty aircraft of the Vertical/Short Take-off and Landing type, it has

come about that one is often forced to compromise between cruise performance on the one hand, and intrinsic stability and control on the other, often to the point of providing electronically controlled assistance in the form of Stability Augmentation Systems, in order to provide for the desired flying qualities. This is particularly true of V/STOL aircraft which are required to possess adequate flying qualities at very low forward speeds, and precise manoeuvre ability down to ground level in the presence of all reasonably possible atmospheric turbulence. It was apparent therefore that the future welfare of the Canadian industrial interest in V/STOL aircraft would be critically dependent on a better understanding of the permissible limits of stability and control parameters, and very possibly on the ability to fly an airborne simulation of new aircraft prior to the first flight of a prototype.

After considerable study the National Aeronautical Establishment concluded that there was an imperative necessity to contrive a method whereby the stability variables of an aircraft and its flight control system could be systematically varied without modifying the basic aircraft configuration, and it was decided that a "model-controlled method" should be used. Briefly, this approach to simulation functions as follows: A helicopter is equipped with an analogue computer "patched" for the characteristics of the equations of motion to be simulated, and providing signals representing the yaw, pitch, roll and heave rates of the vehicle that is being simulated.

The test pilot operates controls that only supply electrical signals to the computer, the electrical signals being proportional to control deflections. The computer output signals, which represent the desired motions of the vehicle being simulated, are compared with the actual helicopter motions sensed by rate gyros, and an auto-pilot operating in a closed-loop fashion forces the helicopter to follow the motions prescribed by the computer. In this way, the pilot is in effect flying the vehicle whose characteristics have been patched into the computer, the natural response of the actual helicopter being almost entirely suppressed. It will be noted moreover that major changes can be made in the characteristics of the vehicle simulated by changing a few potentiometer settings in the computer system. It will be noted also that the effects of atmospheric turbulence on the simulated vehicle can readily be achieved by purely electrical inputs to the computer.

There is, of course, a certain element of risk in such flying because the determination of limits on the values of stability and control parameters involves some flights in which these limits are exceeded. To minimize the risk of disaster, a co-pilot, or rather a safety pilot, sits at the regular controls of the helicopter and by pressing a single electrical contact mounted on the control column he can instantly disconnect the test pilot's control system and assume direct control of the basic helicopter.

The decision to embark on the program was made by the Director, National Aeronautical Establishment, and the costs have all come from the operating budget of the National Aeronautical Establishment supported by the value of two Bell-47 helicopters that were provided at no cost to Canada by the United States Army as an earnest of its interest in the results of the work.

Two simulators of the kind described above have been designed, produced and flown by the National Aeronautical Establishment, and both have been used for major programs of work that have already been of great benefit to Canadian aircraft companies. The total cost of the overall program has been approximately \$200,000, while the benefit directly and indirectly is estimated at several tens of millions of dollars.

The benefit from the work is of two kinds - on the one hand, systematic studies have already been completed on the effects of lateral-directional cross-coupling, of weathercock stability, of dihedral effect, and of control power and sensitivity on flying qualities; the outcome of this kind of work is important to Canadian airworthiness authorities and aircraft designers, besides having been used by Canadian manufacturers in negotiating acceptance of their aircraft in the United States.

On the other hand, the airborne simulator has been used to provide a representation of certain particular aircraft, one of which (the Canadair tilt-wing CL-84) had not then undertaken its first flight. The advantages of being able to investigate the flying qualities of a new type of aircraft without hazarding a prototype aircraft cannot be overstated.

Similar work has been done with the National Aeronautical Establishment airborne simulator for the Hawker P-1127, the Short SC-1, and the DeHavilland Otter aircraft, at the request of the manufacturers, and one element of the present programme is the subject of a contract received from the Cornell Aeronautical Laboratories in Buffalo. Another important use of the simulator is brought out by an arrangement that will see 15 officers of the Canadian Forces receive training on the National Aeronautical Establishment simulator early in 1969, prior to their taking delivery of the Canadian tilt-wing CL-84 VTOL aircraft. This will be a major contribution to flight safety.

A forthcoming program to which the National Aeronautical Establishment is now committed is in support of a Canada/United States intergovernmental agreement to develop a tactical aircraft guidance system. This is a fly-by-wire system in principle, similar to that already incorporated in the National Aeronautical Establishment airborne simulator, and the contract is to the extent of \$15 million worth of research and development also involving a substantial Canadian industrial contribution.

As a result of its work and experience to date, the National Aeronautical Establishment has satisfied itself that an airborne simulator should be regarded as a basic experimental tool of aeronautical science having the same relevance to research and development as does a wind tunnel. The existing simulators are partially adequate to the foreseen Canadian need, but there is an absolute necessity to supersede the present machines with one permitting simulation having 6-degrees-of-freedom, substantially higher speed and substantially higher payload. Agreement with this proposition has been received from all industrial organisations and Government authorities concerned with the work.

ST. LAWRENCE RIVER DEVELOPMENT

A large accurate scale model of the St. Lawrence River from Montreal to Father Point near Rimouski has been constructed. Experiments now in progress will provide basic information on which to plan extensive channel improvements.

Since the earliest days of exploration and settlement, the St. Lawrence River system has been one of the most important transportation arteries in North America, and, since the days of its founding, Montreal, representing until recent years the western limit of deep-sea transport, has enjoyed the advantage of bringing the economies of sea transport far into the North American continent. From the beginning of this century there have been proposals to maintain navigation in the St. Lawrence system on a year-round basis with the object of deriving greater revenue and with the social objective of avoiding the disruption of employment arising from the present intermittent operation.

When political developments made possible the construction of the St. Lawrence Seaway, the Division of Mechanical Engineering began to concentrate more and more on this great waterway. While still involved in work on the mid-part of the Seaway, the Director of the Division of Mechanical Engineering,

foreseeing the impact of the Seaway on river traffic and the inevitable necessity of an attack on the problems of the riverway, decided to initiate an investigation on the various sources of heat loss from the river in winter. In brief the report, published in 1954, estimated that the warm water discharged by nuclear power stations generating 7,000 MW of electricity could maintain a 500-foot channel from Kingston to Montreal in winter. Although an estimate in corresponding terms has not been made for the stretch of river from Montreal to Quebec, the figures would be expected to be somewhat comparable.

With the opening of the Seaway many ocean going ships were able to by-pass Montreal Harbour and penetrate to the Great Lakes. For many years channels have been dredged to permit larger ships to come further upstream and enter the harbour of Montreal. This is a self-limiting undertaking because the same channels that permit the entrance of larger ships lower the water level in the harbour thus restricting the size of ships that may be docked. The practical limit to dredging is now in sight.

In 1961 the general river problem was discussed by the staffs of the Department of Transport, the Treasury Board and the Division of Mechanical Engineering. It was concluded that sufficient immediate improvement could be made on an ad hoc basis and that there was no need for the present to launch a major attack on the problems.

Accordingly the Division of Mechanical Engineering undertook a study of the Fraser River conscious of the fact that the problems of the Fraser were similar to the problems of the St. Lawrence and that the study, valuable in itself, would contribute invaluable knowledge and experience relevant to the problems of the St. Lawrence.

In 1966 the Department of Transport decided that the time had come for a more comprehensive approach to the problems of the St. Lawrence, seeking to improve navigation conditions. The Department enlisted the aid of the Hydraulics Laboratory of the Division of Mechanical Engineering. With money provided by the Department of Transport the Laboratory was extended and a large accurate scale model of the St. Lawrence River from Montreal to Quebec was constructed. Experiments are now in progress over this section. Subsequently the Division of Mechanical Engineering decided to extend the model to Father Point near Rimouski in order to represent clearly the all important tidal motion. This section is nearing completion.

The Hydraulics Laboratory estimates the material cost of the St. Lawrence River model and its instrumentation and data processing and data control equipment at approximately \$600,000. This does not include the cost of the manpower provided by the laboratories' engineers and technicians valued at an additional \$1,000,000 over a seven year period. The final cost is expected to

be in the order of one per cent of the costs of actual construction and channel improvements. A rough rule-of-thumb adds that economic justification of a harbour or river model is achieved if it costs between one and two per cent of the actual project, depending on its magnitude. Model studies may appear to be costly but engineering experience shows that it is essential to perform them.

As a relevant addendum one might mention that the Welland Canal, the next upstream feature of the Seaway system, experienced difficulties and delays in passing ships through the canal thus limiting traffic. Since the time of a large ship is worth between \$6,000 and \$10,000 per day, reducing the transit time makes the use of the canal more economically attractive. The Director of the Division of Mechanical Engineering decided to investigate these delays, the cost to be borne by the Division. In 1966 he submitted a report to the St. Lawrence Seaway Authority setting out proposals for reducing the passage time which if implemented would result in reducing this time from as high as 14 hours to 5 hours. Subsequently the Authority applied some of these proposals and the results of further discussions with the Division to improving the St. Lambert and Côte Ste. Catherine Locks.

BIRD HAZARDS TO AIRCRAFT

Bird damage to jet aircraft continues to exact a serious toll of life and property. A variety of preventive techniques, some of them quite promising, is under study.

The hazard that birds create for jet aircraft is considerable. To date, the RCAF has lost eight CF-104 aircraft (and probably two more), a loss of \$12, 000, 000, as a result of bird strikes. An Air Canada Vanguard, struck by a flock of pigeons, suffered \$100, 000 damage to its engines. Since 1959, the cost to Air Canada alone from bird damage to aircraft is close to \$2, 000, 000. But the real concern is not the loss or damage of physical equipment; it is the fear of loss of life, particularly a catastrophic loss of a passenger aircraft. Two such catastrophes have already been caused in the U. S. A. by bird strikes and the pending introduction of air buses and jumbo jets increases the fear of even worse tragedies.

In 1962, after discussions had taken place between the Department of Transport, the principal airline companies in Canada, the RCAF and the Canadian Wildlife Service, the Department decided to request the National Research Council to look into the problem of bird hazards to aircraft around our airports and along our airways. Council accepted the responsibility and formed an NRC Associate Committee consisting of representatives of the bodies mentioned

above plus representatives of Rolls Royce of Canada, Limited, the Canadian Air Line Pilots Association and the Division of Mechanical Engineering (NRC). Thus the Committee included all of the agencies that were directly involved with the problem and that would be responsible for implementing any decisions.

To support the work of the Committee the Department of Transport has from the beginning made an annual allocation of \$73,000. More recently the National Research Council decided to provide \$25,000 on a yearly basis. In addition, an appreciable amount has been used from the normal operating funds of the Division of Mechanical Engineering. On a single occasion the Division of Radiation Biology provided \$5,000.

In addition, the participating organizations have contributed staff and facilities under their control. Thus the Air Force has supplied transportation, radar consoles, photographers, etc.; the Department of Transport has provided radar stations at airports and men to operate photographic equipment; the airlines have provided statistics and air transportation; the Canadian Wildlife Service has provided trained staff for field surveys and to analyze films at radar stations; and the Division of Mechanical Engineering provided researchers, laboratory space and facilities and the administrative support for the Associate Committee.

Initially the Associate Committee decided to tackle the problem on a short-term basis with established knowledge and techniques. The Canadian Wildlife Service undertook to study birds and their environment around 50 of our Canadian airports. This gave rise to some practical recommendations; the removal of garbage dumps from the vicinity of airfields, the cutting of long grass, the reduction of earthworms all of which were attractants to birds. At the same time bird repellants such as falcons, distress calls, shell-crackers, etc., were studied. Distress calls and shell-crackers are now in use at some Canadian aerodromes.

While these recommendations were most useful and helpful the Associate Committee saw the need for longer term studies. This involved such subjects as the detection of bird migrations by taking time-lapse motion pictures of the birds as they appeared on the radar screen. A chain of twenty-one co-operating radar stations (including one USAF) has been organized in Canada for this purpose. One RCAF station equipped with CF-104's has found it practicable to control its training flights by radar detection of bird hazards. Representatives of the Associate Committee have worked with European agencies to enable the latter to establish a similar chain of fifteen cooperating radar stations in Western Europe and Africa.

It has been observed that in some instances radar has a profound effect on birds, causing a temporary nervous system collapse. Studies are now in progress within the Division of Mechanical Engineering and at Queen's University to discover whether certain frequencies of microwaves can be used to keep birds off airfields or even to 'sweep' them out of the path of an approaching aircraft.

Two other projects have been started on a contract basis with universities. At Acadia University investigators are testing short ground covers (plants) that might be suitable to replace the long grass commonly found around airfields. At the University of Ottawa a service is being established to identify the bird fragments found in malfunctioning jet engines. It is known that small birds up to a certain size are unlikely to damage a jet engine. If the bird fragments in a damaged engine are identified as those of a small bird it largely eliminates a bird strike as the cause of the damage and strongly suggests that another cause of the failure be sought.

This investigation exemplifies the close-knit co-operation of a variety of agencies (made possible through the mechanism of an NRC Associate Committee) producing practical results and the promise of better results in the future.

DEVELOPMENT OF ANALYTICAL METHODS AND INSTRUMENTS IN PHOTOGRAMMETRY

The total volume of work in surveying and mapping in Canada is estimated at over \$100,000,000 annually. Studies culminated in the invention of the Analytical Plotter, a completely new type of photogrammetric mapping system. Further development of the new method resulted in NRC becoming one of the world leaders in photogrammetry and Canadian methods are now used in map production by well over one hundred foreign mapping centers. Canadian government mapping agencies and Canadian industry are taking full advantage of these developments. A monocomparator, a very precise and efficient low-price instrument, has been developed. It will be one of the first products of a new Canadian company.

Canada has very extensive requirements for surveying and mapping that will rapidly increase with the development of the country. It also has either the largest or second largest map-making industry in the world. Therefore, urged on by the Department of Mines and Technical Surveys, a modest research activity in this area was established at NRC in the early fifties; any increase in the efficiency of map-making and surveying not only would benefit domestic operations but also would put Canadian industry in a more favourable position in highly competitive foreign markets. The economic advantages are significant since the total volume of work in surveying and mapping in Canada is estimated at over \$100,000,000 annually.

With the advent of electronic computers, theoretical work was initiated, aimed at developing analytical methods in photo-

grammetry. The decision to embark on this project was made by the scientists concerned in consultation with the Director of the Division of Applied Physics. Study of the instrumental aspects of analytical methods, including rapidly developing electronic computational technology, culminated in the invention of the Analytical Plotter, a completely new type of photogrammetric mapping system. It departs entirely from the established physical projection principles of existing instruments.

Since there were no Canadian companies producing and marketing this type of instrument, no Canadian industry could undertake the development and exploitation of this remarkable invention. A licence was therefore granted to the only foreign company which was willing to develop the instrument. The Analytical Plotter was put on the market in 1961. Its production volume has since surpassed \$6,000,000 and, including the derivative and peripheral equipment, it is probably well over \$10,000,000. The royalties received to date by the Canadian Patents and Development Limited amount to over \$280,000. It must be stressed that the basic concept of the Analytical Plotter generated further ideas now being followed up by scientists and industries in various countries.

Further development of the new method resulted in NRC becoming one of the world leaders in photogrammetry and Canadian methods are now used in map production by well over one hundred mapping centers in Europe, U.S.A., Latin America, Australia,

Japan, etc. Canadian government mapping agencies and Canadian industry are taking full advantage of these developments.

Continuing studies on related instrumentation have produced the NRC-monocomparator. This is a very precise and efficient instrument in the low price range which may be of value to both large and small mapping agencies. A new company is being established in Canada and the monocomparator will be one of its first products.

This project originated in the National Research Council and the decisions to proceed were made within the Division. There was no Canadian equipment industry and it is notable that the two leading manufacturers in the world turned down opportunities to obtain licences. The perseverance of the NRC scientists has resulted in an extremely important new concept in photogrammetry being developed and continuing work in the field is producing further developments which will result in establishment of a new Canadian industry.

CRASH POSITION INDICATOR (CPI)

A Crash Position Indicator was developed that deploys automatically from a crashing aeroplane and continues for several days to transmit radio distress signals enabling rescue planes to home in on the site of the crash with minimum time wasted in searching. A small Canadian company undertook commercial production. The return on this investment to date is about \$15 million in sales, a real or potential saving of several million dollars a year in cost of air and ground searches, and a saving of human life.

The C. P. I. was the National Research Council's answer to a pressing need for an essentially passive and automatic device that could be reasonably guaranteed not to be destroyed when an aircraft makes high speed impact with the ground even at very large nose-down angles. It was also required that the device should not sink in water, should not require any form of human intervention or explosive charge in order to be ejected from the aircraft, and should be able to transmit a radio distress signal for several days.

All these conditions were met by the C. P. I. which deploys by reason of the natural air forces acting on the surfaces of the device, and which is decelerated and steered away from the trajectory of the aircraft and hence away from the point of ground impact.

Several companies took licenses to manufacture the C. P. I., including the maker of the special search equipment used in search

aircraft, but none was able to develop a satisfactory market despite a great deal of assistance from the National Research Council in building and demonstrating models.

Finally, a small Canadian company with faith in the product took a license which was eventually transferred to Leigh Instruments Limited who went into production and won acceptance of the product in the United States. This company has now branched out into other products and has several licenses from Canadian Patents and Development.

Within the National Research Council, and with the cooperation of the Company, the capabilities of the C. P. I. have been extended to deal with release at supersonic speeds, with a form of design suitable for deployment from helicopters, and with the incorporation of a flight recorder in the body of the C. P. I.

It is difficult to separate out the dollar cost of this research and development because other researches were proceeding simultaneously in the same research group, but it is tentatively estimated that a total of about 10 man-years or approximately \$100,000 have gone into the program in salaries for one professional and one technician, and about \$200,000 in support costs.

The return on this investment to date is about \$15 million in sales, a real or potential saving of several million dollars a year in the cost of air and ground searches, and a saving of human life.

The invention and development of this device gave rise to a number of constituent projects of substantial scientific significance that have already made, and will continue to make, an impact on other areas of technology. These, for instance, relate to high energy impact (such as crashing motor vehicles), the effect of blast waves on light structures, the aerodynamics of bodies of varying planform, camber and centre-of-gravity, and the theory of supersonic deployment that will undoubtedly be of value in future generations of high speed aircraft. In recognition of the excellence of all this work, the researcher principally responsible was presented with the McCurdy Award which is the highest award granted in Canada for achievement in the field of aeronautics and space research.

COUNTER-MORTAR RADAR

This is an example of a technical success that was an economic failure. In 1954 a counter-mortar radar was developed which enabled field troops to locate the source of enemy mortar fire. This gave Canada a clear lead of several years over other countries but a number of factors prevented Canada from exploiting the export market. Interest in this type of radar is increasing again, however, and it is likely that in due course a second generation set will be developed through an industry program, and incorporating NRC refinements and improvements.

This is an example of a major project which was a success from a technical standpoint, but a failure as regards the realization of its economic potential.

In 1954, Canada had a lead of several years in the development of counter-mortar radar. This equipment had been developed by the Radio and Electrical Engineering Division as part of its undertaking to provide the Department of National Defence with technical support in the radar field, and is used to locate the source of mortar fire by determining two points on the path of a projectile and extrapolating back to the source. Following the completion of the experimental model there was some delay on the part of the Department of National Defence in proceeding with a production prototype; however, such a unit was completed in 1957 by Canadian Arsenals. There then followed a period of trials culminating in acceptance by the armed forces in

1959; however, there was then a delay of over two years in reaching a decision to proceed with production. Finally, in 1961 Raytheon Canada received an order for 10 units, which was subsequently followed by orders from Germany and Italy for one unit each, for evaluation.

For a number of reasons clearly beyond Canadian control, U. K. authorities, who had followed the Canadian development closely, chose to proceed with their own development, as did the U. S. Over 100 units of the British set were produced, some for export to Sweden and Germany, and an unknown number of U. S. sets were produced, some for export to Holland and Belgium. Furthermore, in spite of the fact that they incorporate many Canadian ideas, the competitive equipments in some respects are inferior - for example, only the Canadian set is equipped with an effective device to counteract the adverse effects of atmospheric precipitation on the performance of the radar.

Apart from the external influences which acted to deny Canadian access to the export market, a number of other factors undoubtedly played a part. These include such unfortunate coincidences as the cessation of production at Canadian Arsenal and problems in vehicular mounting relating to the Bobcat project, and also more controllable factors such as a two year delay between prototype and start of production, and the lack of a well defined and closely coordinated effort to "sell" the equipment in foreign markets.

The Canadian order was completed in 1964, and the units are currently deployed in Canada and with our NATO forces in Europe. Interest in this type of radar has increased in recent years due to the success of the U.S. equipment in Vietnam, and it is likely that in due course a second-generation set will be developed, possibly in cooperation with the U.S. Since NRC relinquished its role in this area in 1965, such a program would be carried out by industry but would incorporate further refinements and improvements previously developed by NRC.

WAVE ABSORPTION BREAKWATER

In stormy weather waves climb the solid front of conventional breakwaters and spill over the top, interfering with ship loading. The concept was developed for a hollow concrete breakwater with openings on the seaward side. These would permit waves to enter the chamber where their energy would be absorbed and spill-over would be largely eliminated. Public Works built a breakwater of this type at Baie Comeau, Quebec and another at Saulnierville, Nova Scotia. Other applications of this concept are possible.

Many breakwaters and coastal works are constructed from heavy stone available in the vicinity; where suitable stone is not available the breakwaters are constructed from concrete. Conventional concrete breakwaters have two significant disadvantages: in stormy weather the waves climb the solid front of the breakwater and spill over the top slowing or stopping the loading of ships; and scouring action at the base washes away the footing rubble, a common cause of breakwater failure.

During their many years of involvement in coastal works the Hydraulics Laboratory became familiar with this problem and one of the research officers proposed that it might be solved by applying the principle of the absorption of sound by perforated acoustic tile. The Director believed this suggestion merited investigation and authorised the researcher to proceed with theoretical studies and

model studies as part of the divisional research programme. This work determined that the idea was hydraulically feasible.

With the progressive developments of the Baie Comeau area improved harbour facilities became a necessity and the Rivers and Harbours Engineering Branch of the Department of Public Works enlisted the aid of the Hydraulics Laboratory as advisers and consultants on the project. With funds provided by Public Works the Hydraulics Laboratory constructed a model of the Baie Comeau harbour area and conducted experiments to determine the basic factors needed to produce a works plan. In their report the Laboratory drew the possibilities of a perforated breakwater to the attention of Public Works.

The novel suggestion interested Public Works and they entered into a design contract with a Montreal consulting firm to determine, among other things, the structural behaviour of the new breakwater and the economics of its construction. There was close consultation between the Montreal firm and the Hydraulics Laboratory in the preparation of this study.

On the basis of this report Public Works decided to proceed with the construction of a wave absorption breakwater at Baie Comeau. The new harbour facility was inaugurated in July 1963 and the breakwater has functioned successfully since. The Division of Building Research subsequently carried out studies to determine

the level and distribution of maximum stresses created by wave motion under actual conditions.

Another breakwater based on the same principle was subsequently constructed at Saulnierville, Nova Scotia.

Applications of this new design to installations other than breakwaters are being considered. It is thought that the idea might be applied to advantage in the construction of platforms for off-shore drilling rigs. In the defence area it would be adaptable to the construction of mobile breakwaters of the Mulberry type used in the Normandy invasion. With the demand for larger and longer aircraft runways thought is being given to extending them out to sea and a wave absorption construction would seem to have some merit.

CONTROL OF COPPER SMELTING

The smelting of copper depends on the subjective skill of the operator in controlling the oxidizing process. A satisfactory instrument was developed that consistently equalled the best human judgment. Another instrument was developed for measuring changes in the conductivity in molten copper sulphide. These two instruments provide accurate automatic control and may eliminate one step from the refining operation.

The smelting of copper involves blowing air through baths of molten material to oxidize and remove sulphur as sulphur dioxide gas. Accurate control of the end point of this operation has depended on the skill of the operator which is not consistent.

A large copper refiner approached the Division of Mechanical Engineering for assistance in solving gas handling problems around the converters. The problem was successfully solved, and as a result of the knowledge of the process gained by NRC staff, the possibility of improved control was realised. A study project was authorised and techniques used in the study of high temperature ionized gases combined with knowledge obtained from the Pure Physics Division resulted in the development of a satisfactory instrument which consistently equalled the best human judgement.

The work consisted mainly in designing a gas sampling system so that an infra-red spectrometer could be used to measure

the SO_2 content of the stack gases above the converter. As the SO_2 content declined toward zero it indicated the end of the blow phase of the operation.

Success with the first instrument led to trials on the use of another research instrument developed for measuring electrical conductivity of gases, for measuring changes in conductivity in molten copper sulphide. This resulted in another control instrument and technique. The two instruments will be very useful in the development of accurate automatic control of the smelting process and may eliminate the need for one step in the overall refining operation.

Well-known techniques used in research were applied to solve an industrial problem through close cooperation between NRC and industry.

COLD STORAGE OF FOOD

The economic advantages of prolonging the storage life of food produced in Canada are obvious. A new cold jacketed storage room was developed that minimized the surface drying of frozen fish and meat, and increased by 50 percent the storage life of fruits and vegetables. The same principle was successfully applied to refrigerated trucks. About 150 of these jacketed truck trailers have been built representing an investment of \$4 million.

About ten years ago the frozen food industry in Canada was faced with two major problems:

- a) During storage, frozen meat and fish dried out on the surface and fresh vegetables wilted and softened, due to condensation of moisture in the room air onto the cooling coils of the refrigeration unit.
- b) Frozen foods rose well above the recommended temperature of 0°F, and sometimes thawed, during long distance transport by road in refrigerated trucks. This resulted from inadequate circulation of air in the load space.

On the initiative of the Director, the Division of Applied Biology had been studying refrigerated storage of food since the late nineteen-thirties. Thus the Division seemed the logical group to study these two problems and did so with the advice and approval of

the Canadian Committee on Food Preservation composed of representatives from federal and provincial government departments, from universities and from industry.

The jacketed storage room was developed to minimize the surface drying of frozen fish. In this envelope system cold air from the cooling coil is confined to an air space between the inner and outer walls, floor and ceiling. The result is uniform conditions of temperature and air movement, as well as high relative humidity, in the storage space which are essential for long-term keeping of frozen protein foods. It was found that this type of room could increase by 50 per cent the storage life of fruits and vegetables where water loss results in wilting, softening, or shrivelling. The Departments of Agriculture and Fisheries cooperated in this work.

At present about a dozen commercial storages of the jacketed type are in operation in Canada. The economic advantages of prolonging the storage life of food produced in Canada are obvious.

Application of the same cold jacket principle to refrigerated trucks solved the problem of excessive warming of frozen foods during shipment. In the development of the cold jacketed truck trailer the NRC was assisted by the Canadian Departments of Agriculture and Fisheries, the National Harbours Board, the Army and Navy, the Canadian Pacific Railway, a brewery, and manufacturers of refrigeration equipment and truck trailers.

The CPR and CNR have put into service about 150 of these jacketed truck trailers with an investment of \$4 million and obvious benefits to the frozen food industry.

MICROWAVE DRYING

Radar waves penetrate substances and can selectively drive off water without heating the material itself. This principle was successfully exploited in the development of new equipment and techniques for very effective and high speed industrial drying applications.

It has long been known that radar waves penetrate substances and cause molecular motion, producing heat. Because water molecules are particularly affected it is possible to drive off water from a material without heating the material itself. This had not found much commercial use because it is extremely difficult to get all the microwave energy into the material; cost and inefficiency made microwave drying economically impractical.

In 1965 the National Film Board in Ottawa was preparing twenty-four foot photographic murals for Expo. Each mural had to be spread out flat for two days to dry. The NFB asked National Research Council if they could design a microwave dryer. The Antenna Engineering group had a prototype in use within 18 weeks, drying the 42-inch wide prints at $1\frac{1}{2}$ feet per minute.

Publicity led several companies to ask NRC for help in applying microwave drying to a wide variety of problems such as drying of tobacco, sausage skins, leather, silk screen printing, and glue.

The lively interest from industry prompted NRC to initiate a project to investigate the application of microwaves to the various problems and as a result several inventions were developed which made the use of this well known technique practical. The first of these was an edgeline glue dryer, developed for R. L. Crain, to dry the glue used on multiple forms. The device was able to operate at 600 feet per minute or ten times faster than conventional methods.

The electronics industry did not show much interest in the work but a Toronto manufacturer of film processing equipment, now Devtek Ltd., saw the possibilities and within a matter of days after consulting NRC was able with their help to demonstrate equipment for film drying to U.S. Air Force representatives. The company rapidly developed competence and is now licensed under several patents and is in production on edgeline glue dryers.

A great deal of testing is required to determine and demonstrate the various applications. NRC is continuing to assist, and Canadian Patents and Development has financed development of some of the necessary equipment. A second contract will assist Devtek in establishing a very good test facility and enable them to take over the investigation of a wide variety of problems.

This project originated with a problem from the National Film Board which was quickly solved. Subsequent industrial interest prompted the Division of Radio and Electrical Engineering to continue its investigation, and the inventiveness of their staff plus the imagination and enthusiasm of Devtek aided by support from Canadian Patents and Development has resulted in a new and very promising industry.

EAR DEFENDERS AND EARPHONES

Noisy industries, the armed services and insurance companies are interested in protecting the hearing of employees. An improved form of ear defender was developed incorporating a novel liquid-filled cushion. Ear defenders of this type are now made by five firms in three different countries. A related development was the mounting of earphones in the ear defenders to produce high fidelity stereo earphones. These earphones are the main product of a Canadian company which now has a branch plant in the United States.

Ever since the publication in 1951 of the report "The Relation of Hearing Loss to Noise Exposure" by the American Standards Association there has been keen interest among individuals, noisy industries, the armed services and insurance companies in the protection of hearing.

A project was started in the Division of Applied Physics to improve on the performance of existing ear defenders. The priority assigned was initially average and was based on the apparent attitude of the public to hearing loss. A request from the Canadian Pulp and Paper Association for help in dealing with the noisy conditions in their industry resulted in the elevation of the project to a high priority. Ear defenders were seen as an early stop gap solution to this problem by protecting the workers until the more basic problem of reducing the noise itself could be solved. An improved form of ear defender was

developed incorporating a novel liquid filled cushion.

Initially there was difficulty in getting an industrial firm to produce the new design, and even more difficulty in persuading workmen to wear the devices. Gradually these resistances were overcome and ear defenders of this type are now made in three countries by five companies. They are now worn by ground crew at most airports. It is estimated that production amounts to \$600,000 annually and that 80,000 people may have been saved from serious hearing damage.

The initial project led on to a related development of an improved method of mounting earphones in ear defenders. This was so successful that it resulted in high fidelity earphones with practically flat frequency response. These are now used extensively for stereo music and by sound crews and TV broadcasters operating in noisy locations. These earphones are the main product of a Canadian company which now has a branch plant in the United States to look after that market.

The initial project was started internally, accelerated by a request from industry and resulted in two products which are being manufactured by two separate Canadian industries.

WELDED RAILS FOR CANADIAN RAILWAY OPERATIONS

The roughness of rail transportation is due in part to the bolted rail joints every 39 feet. The extremes of the Canadian climate had prevented the use of welded rail to eliminate this problem. A system was developed for heating or cooling 1400 feet long welded rails so they could be laid and anchored at the mean climatic temperature. This procedure is now in use.

NRC has been associated with railway research for many years mainly in connection with locomotives and rolling stock. In recent years an NRC Associate Committee has been formed with membership from the principal railways and NRC and a representative of the Association of American Railroads. As a result NRC has started a study of the behaviour of railway tracks in an attempt to obtain smoother operation.

Part of the problem has to do with the bolted rail joints which occur every 39 feet in ordinary rails and must have expansion joints to take care of changes in length of the rail due to changes in temperature. A solution used in milder climates is to weld rails into long lengths and anchor them securely enough to resist the expansion and contraction forces. Canada's wide temperature variations make this solution impractical, particularly when the rails may be laid in the hot Prairie summer and then be subjected to the sub-zero winter temperatures.

It was realised that if rails could be laid at a mean climatic temperature of 65-70°F the welded rail could be practical for this country. The CPR asked NRC to develop a technique for ensuring that long welded rails could be brought reliably to the mean temperature of the climate before being anchored. A decision was taken in the Mechanical Engineering Division to develop a system for heating or cooling 1400 ft. long welded rails, so that they could be laid and anchored at the desired temperature. This procedure is now in use.

Improvements in Canada's railway system as a result of this development will be of great value, particularly in the development of the "land bridge" concept and may give us a competitive edge over the United States railway systems.

MECHANICAL PROBLEMS OF RAILWAYS

Railway air brake equipment leaked so much air in winter that cars became inoperable. Improvement of brake cylinder lubricants and a proper choice of better air gasket materials for operation at low temperatures met this problem. A technique was developed to reduce the occurrence of "hot boxes" in freight cars enabling a Canadian railway to set a new continental record for the low incidence of such "hot boxes". A form of air compressor after-cooler was developed to eliminate the problem of ice in the air brake system in winter. This after-cooler is in production and in use. A computer simulation study is in progress to help study the effect of a wide variety of couplers and draft gears on the ride of freight trains to help evolve means of attaining a smoother ride.

The trend in modern business is towards small inventories. This is based on frequent, reliable, deliveries of stock. To meet this requirement the railways have to run their freight trains at reasonably high speeds with a high degree of reliability. For operational economy these trains have to be as long as possible. It was a shock to one of the railways when their statistics showed that in winter they had to "set-off" (side line) as much as 30% of their normal train lengths and weights. The prime reason was evident; the air brake equipment was really designed to run in warm weather and in the wintertime there was so much leakage from the equipment that cars became inoperable.

Through the medium of the NRC Associate Committee on Railway Problems the railway drew that problem to the attention of

the Director of the Division of Mechanical Engineering and he decided to include a study of this problem within the research program of the Division.

Although quite a bit of detailed work was involved, the brake leakage troubles were overcome, basically, by the improvement of brake cylinder lubricants by the Division's Fuels and Lubricants Laboratory and by the proper choice of better air gasket materials for operation at low temperature. In this work the Division obtained a great deal of assistance from the Division of Applied Chemistry. Satisfactory lubricants and gaskets are now in quantity production in Canada and the problem of reduced winter train loads is solved.

If there is a failure in the lubrication system of the wheels of a railway car, the journal bearings heat up producing what railway men call a 'hot box'. When the brakemen on a freight train detect a 'hot box' the freight car has to be 'set off' for repairs at the next available siding with a consequent decrease in efficiency, increase in operational costs and a decrease in revenue. One of the railways approached NRC directly for assistance with this difficulty. As a reciprocal to the previous situation, this problem was investigated by the Division of Applied Chemistry with a great deal of assistance from the Division of Mechanical Engineering. With the solutions proposed by Applied Chemistry the Canadian railway was able to set a new continental record for the low incidence of 'hot boxes'.

With the advent of the diesel locomotive, trans-continental trains are run from Montreal to Vancouver and back again without roundhouse attention. In wintertime this can result in the gradual accumulation of ice in the air brake system and the eventual stoppage of the train with all the ensuing loss. Through the NRC Associate Committee on Railway Problems, the railway brought this problem to the attention of the Division of Mechanical Engineering and the Director decided that the Division should tackle the problem. By this time the problem had also assumed serious proportions in the operation of rail diesel (short-run) cars in Eastern Canada or on the Prairies. The Division's Low Temperature Laboratory developed a form of air compressor after-cooler which is effectively self-clearing. This has been applied satisfactorily to all the rail diesel cars on one railway, to those in the worst climatic conditions on the other railway, and to a number of locomotives.

There were difficulties in getting the after-cooler into production and in overcoming these the manufacturing company evolved a unique manufacturing process. As 'fall-out' from the main study this process is also applicable to the manufacture of a variety of architectural shapes (door trim, window trim, etc). At present the quantity of these shapes used by the Canadian market does not justify their production in Canada by the normal, expensive rolling technique. The new technique now makes their production possible in Canada and holds some promise of an export market.

The ride of a freight train is far from velvety smooth and the jolting and buffeting causes damage to the lading and the cars themselves. The financial loss caused by this damage was sufficiently high that the Director of the Division of Mechanical Engineering felt it warranted investigation. As an initial step, recording accelerometers were shipped around the country in freight cars to establish the frequency and degree of impacts. In addition a small railway laboratory was established to examine and evaluate the behaviour of a wide variety of couplers and draft gears now on the market. In view of the almost infinite variety of ways in which trains may be made up, it is impracticable to experiment with real freight cars to cover every possibility. In this circumstance the Division has resorted to computer simulation. All these studies are going forward at present. There has already been one significant result. The railways were considering equipping a large fraction of their freight cars with the soft long-travel draft gear specifically developed to reduce lading damage in 'hump' yards. This would have required a very high capital investment. Computer simulation studies showed that this would be undesirable and even disastrous and practical tests have borne this out.

The economic advantages of avoiding bearing failures on trains and the economic advantage of being able to operate full-length trains regardless of the weather are self-evident as are the social

advantages of having reliable brakes. In general, economic aspects of this type of development are being discussed continually with the Canadian Transport Commission, whose interest in the economic aspects is the counterpart of the National Research Council's interest in the scientific and technical aspects.

AIRCRAFT DISASTER AT STE. THÉRÈSE

On November 29th, 1963, a passenger aircraft leaving Dorval International Airport dived into the ground at 500 miles per hour killing all on board. The subsequent investigation involved NRC in 15 man-years of work using the talents of electron micrographers, rubber technologists, instrument engineers, metallurgists, aerodynamicists and system engineers. The Commission of Enquiry was primarily dependent on the technical evidence provided by the staff of the National Research Council to enable it to arrive at an official conclusion.

On the evening of the 29th of November, 1963, a Douglas DC-8 aircraft took off from Dorval International Airport with 118 passengers and crew aboard. Five minutes later the aircraft dived into the ground at an angle of about 55 degrees, and with a speed exceeding 500 miles per hour. The aircraft and the people aboard were fragmented and spread over an area of about 16 acres of boggy bush country adjacent to the town of Ste. Thérèse de Blainville.

This crash gave rise to the most exhaustive investigation in the history of Canadian aviation, and required from the National Research Council a contribution of about 15 man years consisting of senior talent drawn from the Structures, Materials, Systems, Aerodynamics and Flight Mechanics Laboratories of the National Aeronautical Establishment, from the Propulsion, Instruments, Fuels and Low Temperature laboratories of the Division of Mechanical Engineering,

from the Fire Research Laboratory of the Division of Building Research, and from the Division of Applied Chemistry. All the time and material costs devoted to this investigation by staff members of the various Divisions were financed by the Divisions.

Legal responsibility for the investigation was, of course, vested in the statutory authority - the Department of Transport, but recognising the need for massive scientific assistance the Department of Transport requested the National Research Council to accept responsibility for the teams investigating the structure of the aircraft, the power plants and the electrical, radio, hydraulic and pneumatic systems. This was a team of professional talent not available under one organizational roof anywhere else in Canada.

From the start of this investigation it was apparent that it was necessary to make the utmost effort to recover and bring together again all the buried and scattered fragments of the aircraft, and this work was not completed until May 1964. It involved the building of a large coffer dam for the purpose of holding back the more or less fluid clay that constituted the sub-soil, and excavating within the coffer dam to a depth of 48 feet. The cost of this exercise being very high, the decision on the depth of digging had to depend in large measure on the results of a theoretical study made by National Research Council aerodynamics staff of the dynamics of solid bodies moving in extremely viscous fluids such as clay.

About 100,000 pounds of recovered material made up of 100,000 fragments were transported to Dorval airport and work of cleaning, identification and synthesis proceeded for a period of about six months.

By this time it had become clear that the flight path of the aircraft was probably normal to within about one minute of terminal impact, and it became necessary to set up an analogue computer in such a way that the effect of various assumptions on flight path could be compared with the facts that were known or hypothesized. This work was done in the National Research Council and satisfied the investigators that an emergency had occurred about one minute before impact and at about 7,000 ft. altitude. As it was by then known that no air collision or in-flight structural disintegration had taken place, and as it was also known that engine malfunction could be ruled out as a possible cause, the whole investigation concentrated on the possible causes of loss of control.

During this phase of the investigation scientific specialists of very many kinds in the National Research Council were called upon to contribute their expertise. There were electron micrographers examining fracture surfaces and lamp filaments, rubber technologists to decide whether tires burst before or on impact, structural analysts to interpret the deformation of structural members, instrument engineers to deduce the readings of instruments at the moment of impact, and chemists to investigate the possibility of in-flight fire. There were

also metallurgists to do exhaustive mechanical and physical tests on the metals used in the aircraft, aerodynamicists to investigate the behaviour and controllability of the aircraft at speeds higher than the design speed, and systems engineers to prove or disprove the in-flight integrity of every functional system in the aircraft. In fact, all the physical and intellectual resources of the National Research Council laboratories were applied to the investigation, as they had been in the earliest recovery phases of the investigation when National Research Council staff had operated around the clock on the basis of two 12-hour shifts per day.

As a result of all this work, the public hearings of the Commission of Enquiry under Justice Chalmers, were primarily dependent on the technical evidence provided by National Research Council staff, and the investigation came to an official conclusion in June 1965, about 19 months after the accident.

The Enquiry concluded that the "most probable cause" was the malfunction of a small electro-mechanical device known as a pitch trim compensator. Corrective action was taken, and no similar occurrence has transpired since that time.

This case history illustrates how, in times of emergency, the National Research Council can marshal from its own resources an experienced task force of experts from many scientific disciplines to provide a solution to critical problems.

IMPROVEMENT OF SEALED DOUBLE GLAZING

The value of sealed double glazing used in Canada now approaches \$20 million per year. When this new form of insulating glass was first introduced a number of small, inexperienced, companies entered the market and offered units with the same guarantees as the original companies, at greatly reduced prices. A chaotic situation developed when these products failed to perform as guaranteed. To meet this urgent situation, tentative test procedures and criteria were devised. Now a national standard has been prepared and the previous difficulties have been largely eliminated.

Factory sealed double glazing units, also called insulating glass, are now used extensively in residential and commercial buildings. They were first developed and widely promoted by two of the large glass manufacturers on this Continent under the trade names "Thermopane" and "Twindow". The plastic type edge seal used by one of the companies was widely copied by a number of small Canadian companies. These companies were, in most cases, unaware of the many technical complications some of which had been extensively studied by the two original companies. Unburdened by heavy development costs, they offered units with the same guarantees as the original companies, but at greatly reduced prices.

A chaotic situation soon developed. The two large companies were faced with serious competition, often from inferior products. A number of the smaller companies went out of business because of failures of their units within the five-year warranty period, and users were confused as to how to evaluate the units being offered as to possible

service life.

Central Mortgage and Housing Corporation having responsibility for the quality of Canadian housing, as well as for mortgage operations under the National Housing Act, also had difficulties. Assistance was required in the evaluation of the products submitted by manufacturers for acceptance by the Corporation. A request was made to the Division of Building Research (DBR), National Research Council, which has since its formation in 1947 assisted the Corporation in technical matters related to housing. The request was carefully considered by the Director, after discussions both within the Division and with CMHC, and a final decision was made to accept the project which would be carried on by the Building Services Section of the Division. The Section Head was made responsible for the management of the work involved, employing staff, facilities and budget normally assigned to his Section.

Since no accepted evaluation procedures for sealed glazing existed, and since it was urgent that some guidance be given quickly, it was decided to establish tentative test procedures and criteria and to proceed with tests on manufacturers products as required. Information from this testing, as well as other laboratory and field information, were accumulated and were used in successive revisions of the test methods and criteria as knowledge of the performance of the units and the service requirements improved. The two original companies assisted greatly by sharing information with DBR. Smaller companies contributed

information and shared in the growing pool of knowledge as they came to discuss difficulties and failures with DBR. Information was exchanged with building research workers in other countries, who in some cases came to Ottawa specially for discussions.

There is now a greatly improved understanding by many in Canada, including manufacturers, of what is required in sealed glazing units. The recently-formed trade association gives much credit to the program for the present satisfactory state of their industry. A national standard has now been prepared in Canada for use in government purchasing and by others. A similar standard is being considered in the United States and will benefit from Canadian experience. The burden of testing, according to the new standard, has now been assumed by another agency. Prospective users may now select units from manufacturers who have demonstrated that they can meet the standards. The previously unsatisfactory situation has now become an orderly and generally satisfactory one.

The economic implications of this work are very great. The value of sealed glazing used in Canada is now approaching \$20 million per year. Much of this business has been obtained and held by smaller Canadian firms. The quality of the products offered is now greatly improved and premature seal failures which had in the past been quite common, requiring replacement of as much as 100,000 sq. ft. of glazing in one notable case, are now relatively rare. The

benefit to Canada is almost certainly in the millions of dollars per year. The improvements in quality have led to an approximate doubling of the expected life, and the costs of this extremely popular form of glazing have been drastically reduced.

REDUCTION OF BUILDING COSTS THROUGH IMPROVED INFORMATION ON SNOW LOADS*

A 40% reduction in snow load specifications for roofs has been made as a result of an NRC cross country study. The result has been a substantial reduction in building costs estimated at \$3 - 10 million annually.

Prior to 1953, each municipality in Canada decided on the snow loads to be used in the design of building structures within its jurisdiction. When the 1953 National Building Code was issued for consideration and adoption by municipalities in the interests of better and more uniform municipal building by-laws, a consistent system of arriving at design snow loads was proposed for guidance. Since there were very few recorded observations of amounts of snow on roofs, the probable roof loads had to be estimated from the available weather records of snow accumulations on the ground. It was recognized that roof loads might not be the same as ground loads, and that the method proposed would lead to overly conservative values. There was no choice, however, in the absence of any better information. The ground load method yielded values which checked reasonably well with those already in use in some of the larger cities.

The problem of determining snow loads on roofs was passed by the Associate Committee on the National Building Code to the Division

*'Snow Load' means the weight of snow that the roof of a building must be designed to support.

of Building Research. Assistance of this kind in the continuing improvement of the National Building Code was recognized as a responsibility of the Division of Building Research from its inception and the National Research Council directed that the Director of the Division should also be the Chairman of the Associate Committee in order to ensure the appropriate linking of the work of the Division to the needs of the Code.

Such a request, therefore, was one to be received favourably, subject only to available resources. A ten-year survey of roof loads has been completed at some sixty stations across the country by volunteer observers resident at the various sites. The information gathered each winter has been collected, collated and studied by the Building Structures Section of the Division as one of its regular projects requiring on the average the time of about one man, apart from the field observers. The cost of the project, including modest hourly rate payments to the observers, was met from the Division's regular budget.

It soon became apparent that the loads on most roofs in areas with frequent winds never equalled those on the ground, but some sheltered roofs and roofs which received drifting snow from higher roofs had higher loads. It was found to be possible to recommend a first reduction of 20 percent, and later a 40 percent reduction in the previously specified snow load values. These recommendations

were accepted by the Associate Committee. The net result has been a substantial reduction in the snow load values used in design and therefore in the cost of roof structures and this has been possible because of the new information developed by the survey and subsequent studies. The results have been incorporated in new editions of the National Building Code. A paper on the subject of snow loads on roofs was prepared jointly with a member of the Building Structures Research Institute of the USSR and presented before the International Council for Building Research (CIB).

The cost of the project was about \$22,000 per year. The savings represented by the reduction in quantities of materials used in roof structure is estimated to be at least \$3 million per year, (which is the annual budget of the whole of the Division of Building Research) and possibly as high as \$10 million per year.

RADIATION BIOLOGY

There is a long range national need for sound and expert advice to the Government on all aspects of protection against radiation both in peace and war. To provide this requires a group actively engaged in radiation biology.

The discussions and decisions which resulted in the formation of NRC's Radiation Biology Division took place between 1957 and 1964. In order to appreciate them it is necessary to recall the political and emotional atmosphere of those years. Atmospheric testing of nuclear bombs by the U.S.A. and the U.S.S.R., and the radioactivity levels of fallout debris, were increasing year by year, and culminated in the enormous blasts by Russia in the fall of 1962. The cold war reached some minor and major crises during that period, e. g., the U-2 spy plane incident and the Cuban confrontation.

The result was that public opinion was aroused on the hazards of ionizing radiation. Political and scientific leaders were constantly under pressure to "do something". This pressure has declined greatly since the signing of the Test-ban Treaty in 1963 (by the U.S., U.K., and Russia but not France and China) and the consequent reduction in new radioactive fallout in the northern hemisphere.

In the world of the future there is, and will continue to be, an urgent need for our government to have available to it quickly and

at all times sound advice on the hazards of ionizing radiation, and on methods of reducing, ameliorating, or protecting against such hazards, both in time of peace and of war.

With all these things in mind, H.B. Newcombe of AECL's Chalk River Nuclear Laboratories in 1957 documented the case for an increase in Canada's research efforts in radiation biology. He made the following points:

- the only program of radiobiology in Canada of "critical size" was that at Chalk River and it had not increased at all in ten years.
- Canada's annual expenditure on radiation biology was lower by a factor of 3-5 than that of other pioneers in nuclear science.
- while the levels of radioactive fallout were known with some precision the biological effects of these levels were almost unknown in any quantitative sense.
- Canadian diplomats in the United Nations were calling for more efforts in radiobiology while nothing was being done at home.

Newcombe put his case for an increased program first of all to AECL but AECL officials took a firm stand against any increase of staff at Chalk River. They justified this by pointing out that their primary responsibility had changed from research to engineering for nuclear power.

Newcombe then sought group support to bring about the necessary increase in support. He began with the Genetics Society of Canada early in 1960 which formed a Committee on Radiation Biology. This committee, with the financial and moral support of NRC and AECL, organised a symposium of research directors in radiobiology from the U.S. A. and Canada at NRC in Ottawa. This meeting, which was held in the fall of 1960, recommended to the NRC that it should form an Associate Committee on Radiation Biology to carry on the work of the group. This was agreed to by the Council of NRC in November 1960 and the Associate Committee was formed.

By this time (the end of 1960) Newcombe had persuaded G. C. Butler to join the campaign and the latter broached the subject with C. J. Mackenzie in the fall of 1960 and with E. W. R. Steacie early in 1961. Butler agreed to help in any way possible, even to the extent of directing a program within NRC if the Council established a laboratory of radiation biology.

Early in 1961 the Associate Committee recommended

- (a) special support for radiation biology in universities in order to train more researchers, and
- (b) the establishment of a central research institute in radiation biology, preferably in Ottawa. However, at a meeting in March 1961 the NRC Standing Committee on Biology recommended against both these proposals. It advised that

(A) university support should be provided through the existing screening committees, and

(B) that "...the appointment of two or three key scientists to the staff of the Division of Applied Biology would permit the present program of work to be extended in the field of Radiation Biology."

(A) proved ineffective and (B) was never acted upon.

In the meantime Butler was planning an NRC Division of Radiation Biology with Steacie of NRC, J. L. Gray of AECL, and R. F. Farquharson of MRL, recommending that it should be in Ottawa and ascertaining from DRB and DNHW that it did not conflict with their programs.

Early in 1961 a House of Commons Special Committee on Research was formed and inspected AECL and NRC. When the case for a stronger research effort in radiation biology was presented to them by Newcombe and Butler, they agreed to support it and so recommended in their report to Parliament in June 1961.

By August 1961 the NRC Standing Committee on Biology had reversed its stand and recommended that NRC should establish a budget and appoint a director for a national laboratory of radiation biology. At the Council meeting of November 1961 this was agreed to, Steacie was asked to obtain approval of Treasury Board, and Council agreed that Butler should be asked to become director of the laboratory.

Steacie took all the necessary steps, including clearing the project with AECL, DRB, and DNHW, and on June 29, 1962,

Cabinet gave approval to the establishment of a Radiation Biology Division in the NRC. However Cabinet made implementation conditional upon Treasury Board allotting staff positions and funds. About this time a severe "freeze" by government came into effect and nothing was done for a year and a half even though NRC had allotted a budget of \$30,000 capital and \$50,000 operating for 1963-64. Finally in 1964 the Department of Public Works began to prepare the design of a laboratory of radiation biology and Butler began to recruit staff.

By an agreement with AECL the new staff were to be accommodated at Chalk River as guest workers. Although AECL had agreed to provide laboratory space, the question of housing in Deep River had somehow been overlooked in the discussions, and when Butler began to recruit staff to work at Chalk River he found there was nowhere for them to live. He therefore decided to move to the NRC Building on Sussex Drive, Ottawa, into 2,000 sq. ft. of borrowed space.

Recruiting continued slowly during 1965 but it was severely limited by the lack of space. In October 1966 the construction of the new Radiation Biology Laboratory, M-54, began at the Montreal Road. The staff moved into this new building in June 1968.

In 1965 the Division had begun operating with a director and six scientists in two sections studying (a) the effects of radiation on animal cells and (b) biochemical changes produced by radiations

and the metabolism of radioactive substances in animals. It was planned to expand this program into other fields such as radiation biophysics and radiation genetics as soon as space was available in the new laboratory, but current budgetary restrictions have slowed this development.

In July 1968, the Division of Radiation Biology was joined with two thirds of the Division of Biosciences to form the Division of Biology. This was done on the recommendation of a Biology Review Committee.

The final phase in the grouping and realignment came in October 1968 with a decision to have the eight-man radiobiology team of DRB join the thirty-man NRC group and work in the new NRC laboratory.

The potential value of this proposed program to Canada cannot be appraised in simple economic terms. Its most important contribution concerns a long range national need for sound and expert advice to the government on all aspects of the protection of the different segments of the Canadian population against nuclear radiations in both peace and war. This advice can only be provided adequately in a rapidly changing nuclear age by a group actively engaged in research in radiation biology.

THE 30-FOOT WIND TUNNEL

There is an urgent industrial requirement for a large, low speed, wind tunnel for testing powered models of vertical/short take-off and landing aircraft. Construction is now largely complete and the tunnel is expected to be in operation by March 1969.

In May 1962, the Associate Committee on Aerodynamics which consists of representatives of Industry, Universities and Government formally reported an urgent industrial requirement for a large low speed wind tunnel suitable for testing powered-models of V/STOL aircraft (Vertical/Short Take-off and Landing aircraft).

This proposal was studied during the period May 1962 to March 1963, and as a result of the study the Technical Advisory Panel of the National Aeronautical Research Committee recommended that the project should be regarded as having first priority national importance. In April 1963 the National Aeronautical Research Committee itself (the membership of which consists of the Deputy Ministers of Transport and of Defence Production, the Chairman of the Defence Research Board, the President of the National Research Council, and the Chief of the Air Staff) agreed that the project should be undertaken, and that the National Research Council should be the responsible authority.

Planning was therefore started by the National Aeronautical Establishment, and a special Government/Industry committee was set up to prepare an agreed specification of the new tunnel that would satisfy all the foreseeable industrial requirements.

In February 1964, Mr. C.M. Drury, Minister of the Department of Industry, submitted a letter to the Treasury Board requesting approval of the planning, construction and operation of a 30-foot wind tunnel, and in March 1964 the project was approved by Treasury Board letter TB 622583.

From March 1964 to July 1964 the Government/Industry committee worked on the preparation of a Specification that would represent the best compromise between the cost and the consolidated industrial requirements; in July 1964 the Specification was circulated to all the interested Government Departments and industrial companies for comment; subject to minor suggestions, approval was unanimous.

With the Department of Public Works acting as procurement agent for the National Research Council, a firm of consulting engineers was appointed to the project in October 1964, and a contract was written providing for a definitive design study to assess the probable total capital cost of the project. While this study proceeded, soil boring tests at the proposed site for the tunnel were made; during the same period, a one-tenth scale model of the tunnel was built by the National Research Council and tested to prove the technical admissibility of the Specification.

The final report on the design study was produced in March 1965, and at this time it was predicted that the total capital cost of the project would be \$6 $\frac{1}{2}$ million. In view of the fact that this cost was higher than expected, the National Research Council provided the Treasury Board (May 1965) with a detailed re-analysis of the financial details of the project, and requested formal reapproval of the project.

At Treasury Board request, the Department of Industry and the Science Secretariat reviewed the economic implications of the proposed wind tunnel for Canadian industry, and recommended that the construction of the tunnel should proceed on the basis of an estimated total capital cost of \$6.5 million. This recommendation was accepted by Treasury Board, and formal approval to continue was given by Treasury Board to National Research Council in document TB Number 645046, dated 26 August, 1965.

During the period November, 1964, to October, 1965, a proposal was received from a Toronto organization that the wind tunnel should be located in Toronto, and a similar proposal of equal validity was made on behalf of Montreal by a Montreal organization. It was also necessary to consider the location of the tunnel in the light of the expressed Government desire to limit Government capital expenditure in the Ottawa area.

This was a particularly difficult issue to resolve because there were already in existence in the National Research Council a

number of expensive installations and services that were essential to the operation of the new tunnel, and that would require to be duplicated in whole or in part if the tunnel were located elsewhere. These were, inter alia, a very large compressed air plant, a steam-supply plant, a model-making shop, and various instrumentation and data processing back-up facilities with an aggregate estimated value of about \$1 million. It was also necessary to ensure that the full measure of military or commercial security could be guaranteed for wind tunnel work requiring secrecy.

The final decision to locate the wind tunnel in Ottawa was made by the Government on primarily economic grounds.

During the next 12 months, until the first building contractor arrived on the site, detail designs were largely completed by the consulting engineers, contract documents were prepared and tests were completed on a scale model pilot tunnel. The first contractor moved onto the site in October 1966, and since this time all contracts have been let, construction has been largely completed, and the planned phasing of events is expected to lead to the first running of the tunnel in March, 1969. The present predicted total capital cost is within \$6½ million plus the customary 10% tolerance conceded by the Department of Public Works.

On account of the serious escalations in costs in the Canadian economy generally that have taken place in the past few years, a number of changes have had to be made in the original specification of the tunnel. These have had the effect of somewhat reducing the total technical efficacy of the tunnel as originally conceived, and at a later date it will probably be necessary to restore to the tunnel some of the technical elements that are now absent.

CHURCHILL RANGE FOR UPPER ATMOSPHERE RESEARCH

The Churchill Rocket Range was built by the U.S. Department of Defense for upper atmosphere research. Rockets were regularly fired at no charge for Canadian university and government scientists, with NRC support. In 1963, discussions began, advocating an enlargement of spending on space research, and leading to a Cabinet decision in early 1965 to take over management of the range on a shared cost basis.

The Churchill Range was built by the U.S. Department of Defense at an approximate cost of \$8 million, and was operating in 1963 at an annual cost of about \$4 million.

Prior to 1963, research on the upper atmosphere was being conducted by a number of university and government scientists with NRC support using the U.S. rocket range at Churchill, Manitoba. The research scientists were mounting their experiments in Canadian made Black Brant rockets purchased by the Division of Pure Physics of NRC with payload engineering and construction supplied by the Radio and Electrical Engineering Division of NRC. The rockets were manufactured by Bristol Aero Industries Ltd. of Winnipeg, and had been developed by that Company and its sub-contractors, with co-operation from the Canadian Armament Research and Development Establishment and the National Aeronautical Establishment. They were fired by the U.S. Department of Defense at no direct cost to the National Research Council.

In July, 1963, a proposal was put forward by seven individuals (engineers and scientists - two from universities, two from government research agencies, and three from industry) to the President of the National Research Council. This proposal advocated a tenfold increase in spending on space research, and the creation of a "Space Establishment".

The President of NRC referred the "group of seven" proposal to the Executive Committee of the National Research Council's Associate Committee on Space Research for their study and advice. The Executive reported in August, recommending the takeover by Canada in 1965 of the responsibility for the operation of the Churchill Research Range and the acceptance of a share of the operating cost. The report also put forward three alternative proposals as to the way in which a Canadian space agency might be organized.

Early in 1964, the U.S. Embassy sent a note to the Department of External Affairs concerning the future of the Churchill Research Range. The Department convened an interdepartmental meeting in July 1964 to evolve the Canadian position. In August, a meeting of Canadian and U.S. officials was held in Ottawa to discuss the future of the Range.

In the interdepartmental meetings it was ascertained that the only Canadian agency with an interest in operating the Range was the National Research Council.

In August 1964, a special meeting of the National Research Council was held to consider the future of upper atmosphere research, and the possibility of NRC assuming responsibility for the operation of the Churchill Research Range. Council decided in favour of pursuing upper atmosphere research because of the unique conditions at Churchill, which because of its location with respect to the earth's magnetic field lies directly beneath the northern auroral belt, and is one of the few land locations from which rockets could be fired into auroral phenomena. Council recommended that the Canadian government follow this course of action, and that an additional appropriation be sought to enable NRC to assume the obligations.

Discussions were held between the President of NRC and the Chairman of the Committee of the Privy Council on Scientific and Industrial Research. Council's recommendation was transmitted with supplementary information to the Minister.

At the ministerial level the interrelation between expenditure in operating the Churchill Research Range and expenditure by the Department of Defense Production in support of a production capability in the defense field became apparent. Meetings were held with officials from DDP, DRB, DOI and NRC. It was concluded that neither the production capability nor the Churchill Research Range would be a viable proposition without the existence of the other. Consequently, the decision must be to support both, or neither.

By December 1, the Chairman of the Committee of the Privy Council on Scientific and Industrial Research, who also held the portfolio of Minister of Defense Production, submitted a proposal for approval in principle to the Treasury Board for the funding of the Churchill Research Range.

Treasury Board, in January 1965 sought the advice of the recently appointed Director of the Science Secretariat.

In mid-January, the President of the National Research Council recommended to the Under-Secretary of State for External Affairs that a one-year extension of the existing agreement between Canada and the U.S.A. be sought because time had virtually run out to conclude a new agreement which could be implemented prior to June 30, the expiration of the existing agreement.

A Cabinet decision was taken February 23, 1965 to authorise the Canadian assumption of Range operation and consequent cost sharing.

Sharing of the Range cost by Canada began on July 1, 1965.

The operation of the Churchill Research Range was taken over by the National Research Council on behalf of Canada on January 1, 1966.

It will be seen that dialogue between many individuals and organizations took place over a period of approximately two years

before a decision was made at Cabinet level that upper atmosphere research would be continued at an increased cost to Canada using the Churchill Range. In order to achieve a reasonable cost/benefit ratio relevant to Range operation, NRC decided to increase the support of upper atmosphere research, particularly within the universities, over the immediately ensuing two or three years.

THE SELECTION AND INITIATION OF
PROGRAMS AND PROJECTS

There are at least four fairly distinct ways in which research and development programs or projects come to be proposed, as follows:

1. Some other organization or some special individuals have a need or a problem, and come to NRC for the technical skills.

Selected examples from the NRC case histories are:

-- Innovations in Military and Geophysical Airborne Magnetometry (Page 53)

- need brought to NRC by the Department of National Defense.

-- Vascular Suturing Instrument (Page 67)

- need brought to NRC by two Ottawa surgeons.

-- Brain Cooling for Surgery (Page 69)

- need brought to NRC by an Ottawa surgeon.

-- Bird Hazards to Aircraft (Page 83)

- need brought to NRC by the Department of Transport.

-- Control of Copper Smelting (Page 99)

- need brought to NRC by a large copper refiner.

-- Microwave Drying (Page 104)

- need brought to NRC by the National Film Board.

-- Welded Rails for Canadian Railway Operations (Page 109)

- need brought to NRC by Canadian Pacific Railways.

-- Aircraft Disaster at Ste. Thérèse (Page 116)

- need brought to NRC by the Department of Transport.

2. An important need is identified by NRC scientists themselves, a need to which they feel their knowledge and skills can provide a unique and valuable solution.

Selected examples from NRC case histories are:

- Development of an Airborne Flight Simulator (Page 73)
- Development of Analytical Methods and Instruments in Photogrammetry. (Page 87)
- Crash Position Indicator (Page 90)
- Wave Absorption Breakwater (Page 96)
- Cold Storage of Food (Page 101)
- Ear Defenders and Earphones (Page 107)

3. A possible economic opportunity for a new product or process is spotted by NRC Scientists, who have reason to think that their technical knowledge and skills can bring the new product or process into being.

Selected examples from the NRC case histories are:

- Spherical Agglomeration of Materials (Page 32)
- Development of Rapeseed as a Crop in Canada. (Page 44)

4. A particular technical area is identified by NRC as of special national interest either broadly to a particular industry or because of other national needs.

Selected examples from NRC case histories are:

- Continuing Research Program on Fatigue of Materials. (Page 25)

This program has been recognized as of continuing significance to Canada for 20 years, and as a continuing

program it is monitored by the Associate Committee on Aeronautical Structures and Materials.

--Development of an Airborne Flight Simulator (p. 73).

The need for this facility was recognized by the National Aeronautical Establishment and the decision to embark on it was made by the Director.

--St. Lawrence River Development (p. 79). This is a somewhat special case. The forthcoming need for such a program was recognized very early by scientists in the Division of Mechanical Engineering and some modest work was initiated in the 1950's. In 1966 the Department of Transport decided that the time had come for a comprehensive approach and provided funds for model construction.

--Bird Hazards to Aircraft (p. 83). This problem was urged on NRC by the principal airline companies after Department of Transport discussion with the RCAF, and the Canadian Wildlife Service. An Associate Committee was formed which included all the agencies directly involved that would be responsible for implementing any decisions.

--Mechanical Problems of Railways (p. 111). This program was brought to the attention of the Director of the Mechanical

Engineering Division of the NRC Associate Committee on Railway Problems.

- Reduction of Building Costs through Improved Information on Snow Loads (p. 124). This problem was recognized and passed to NRC by the Associate Committee on the National Building Code.
- Radiation Biology (p. 127). The national significance of this area was urged by two scientists, a committee of the Genetics Society of Canada, an Associate Committee of NRC, and a House of Commons special committee on research.
- The 30 foot Wind Tunnel (p. 133). The national significance of this program was first raised officially by the NRC Associate Committee on Aerodynamics and the Technical Advisory Panel of the National Aeronautical Research Committee, and the National Aeronautical Research Committee itself.

Of all the programs and projects proposed, only a selected few ever reach the stage of initiation in any major way. There has to be - and is - a stringent selection procedure. This works in a fairly simple and understandable way. If the program or project is a relatively small affair, as far as effort is concerned, the individual scientist may make the decision himself; if a commitment of several people is involved the decision will involve the Section Head and usually

also the Division Head; if major capital expenditures are involved, and commitments extending over several years into the future, the Division Director, the National Research Council, and usually the Treasury Board all get involved in making the decision whether to initiate.

As is evident from these examples, other Federal Departments, industries and universities all influence the selection and initiation decisions, and the formal mechanism through which this occurs is either the associate committee, the standing committee, or special advisory committees formed as required. Each of the larger divisions has an advisory committee which reports to the Council itself. These advisory committees regularly review all work in progress and assist in assessing major research proposals.

Three rather special case histories have been provided which illustrate the rather extensive consultation and complex decision making when particularly large and long term commitments are involved. These three cases are:

-- Radiation Biology (Page 127)

-- The 30 foot Wind Tunnel (Page 133)

-- Churchill Range for Upper Atmosphere Research (Page 138)

Each of these is quite different in major aspects. The first involved the initiation (in NRC) of a major long range research program to provide back-up information and expertise on all aspects of the protection of the Canadian population against nuclear radiation in both

peace and war.

The second involved the construction and operation of a major testing facility to back up the aviation industry in Canada in the design of vertical and short take-off and landing aircraft.

The third involved the takeover of the management and roughly half the financing of a rocket range facility which had been constructed, operated and financed by the U. S. Department of Defense.

About the only really significant generality which emerges from these examples, is that decisions on the initiation of relatively small research and development programs and projects are usually relatively easy to make; such programs and projects are usually fairly amenable to cost-benefit analyses of an accounting sort, and the amounts involved are relatively small. But decisions on the initiation of relatively major research and development programs and projects are usually arrived at with great difficulty; the potential benefits are so large and pervasive that cost-benefit analyses of a strict accounting sort lose their credibility; the arguments pro and con begin to depend more on the imagination, vision and expertness of the proponents and detractors than anything else. Moreover, the ultimate success of such programs depends in large measure on the imagination, dedication and skill of those charged with the execution of the program.

THE MONITORING OF PROGRAMS AND PROJECTS
THE ESTABLISHMENT OF PRIORITIES
THE TERMINATION OF PROGRAMS AND PROJECTS

The monitoring of any human activity, the establishment of priorities, and the making of decisions to terminate such an activity, become simple if measurements of value can be expressed adequately in terms of a single index. The "present dollar value of future benefits" is such an index and has considerable appeal in "cost-benefit" analysis.

Unfortunately, as was mentioned in the introduction, for many if not most research and development activities the enforced use of a single index is a Procrustean bed. A multidimensional problem can be expressed in a single index only if one ignores all the dimensions but one.

The monitoring of research and development programs and projects, and the determination of priorities, is intrinsically very complex, with many different factors each one of which must be taken fully into account. There is no simple way of combining them into a single index; rather the monitoring of research and development programs and projects always becomes in the end, a matter of considered judgement. The main dimensions or factors which have to be evaluated and taken into account in monitoring any research and development program, though listed in different ways by different research directors, end up including, in various ways, the following factors:

- I. The Scope of the program or project and its specific objectives and goals.
- II. The Need for the expected technical outputs.
- III. The expected Benefits or Opportunities for the funding agency (be it a company, an industry group, government, or other).
- IV. The Specific Practicality of the program or project including availability of resources.
- V. Where specifically, the best place and best organisation to execute the program may be.

Under Scope for example, one might find that the program was a long continuing one (e. g. Physical Standards) with deep and continuing problems - or a short specific project (e. g. Vascular Suturing Instrument) in which there is a specific and limited product or process objective.

Under Need for example, one might find the program was filling a broad long term national need (e. g. Radiation Biology) or a specific product need (e. g. Wave Absorption Breakwater).

Under Benefits or Opportunities one might find the program to be one of wide industry support significance (e. g. The 30 Foot Wind Tunnel) or to represent a specific new business (Precision Potentiometers).

Under Specific Practicality one must consider the expectation that the technical barriers can be surmounted, that the

probable time scale is tolerable, that the costs in money and people are tolerable, and that the people with the needed skills are available or can be reasonably assembled.

The question of where is particularly important. Is NRC the appropriate organization to execute the program or not?

A program or project might well score very high on Scope, Need, and expected Benefits for instance - but fail completely on Specific Practicality.

It is sometimes difficult to be thoroughly objective and realistic in one's appraisal of these factors - both for the expert who is familiar with the facts, but who is personally involved, and for the non-expert who may not be involved, but for whom the facts are an enigma. However, the process of monitoring and priority setting is a very lively one and goes on continuously in much the same way as selection and interaction. That is to say, if the program or project is a relatively small affair in terms of effort, the individual scientist will carry on these functions himself. If there is a larger effort involving several people, the Section Heads and probably the Division Director will also be involved.

There are, additionally, broader monitoring and priority determining mechanisms. The Council's own associate committees, advisory committees, standing committees, and special review committees provide a continuing evaluation of ongoing programs. There are also less formal, but more stringent monitoring mechanisms.

The scientific community always receives with eagerness the publication in journals or as patents, or the presentation at technical meetings, of the results and findings of a research program or project, and provides a vigorous, critical and relentless monitoring mechanism on the strictly technical side. To this technical interaction is added an intimate interrelationship with industrial companies throughout Canada as well as in other countries. As with any human endeavour which is concerned with futures, mistakes are inevitably made from time to time. Hind-sight is always surer than foresight. But the scientific community on the whole probably applies more intensive self-monitoring procedures to research and development programs and projects than almost any other future-oriented segment of the human community.

The "termination" of research and development programs and projects is much discussed currently, usually in the context of cost benefit discussions, and especially from an accounting point of view. Actually the termination of a research and development program or project in an accounting sense, and the termination in a technical sense are usually quite different matters. For example NRC has had long standing programs in the development of physical standards, and in the fatigue of metals - and from a technical point of view these are continuous programs of prime significance. For accounting purposes however a series of particular projects appear by name in the records, are "executed" and then "terminated". The "project terminations"

are really rather artificial and represent an attempt by technical management to meet the formal demands of annual accounting. This is an illustration of the point made in the introduction - that some radically new accounting and fiscal imagination is needed to match the demands of the technical business age.

From time to time, however, termination of technical work areas does occur because the individual scientist, the Section Head, the Division Director, or the Council, come to the conclusion that the area is no longer of priority significance, or that the work should be transferred elsewhere. Some selected examples from NRC history are:

Properties and techniques of Wooden Aircraft Structures

- terminated in 1946

Spinning of Aircraft - terminated in 1949

Fluidized Bed Program - terminated in 1960

Aircraft Ski Development - terminated in 1953

Rocket Payload Engineering - terminated in 1966

Military Electronics - terminated in 1963

Gas Turbine Locomotive - terminated in 1966

Railway Diesel Engine Locomotive Program - terminated in 1968

Fraser River Hydraulic Study Including Port Design for

New Westminster - terminated in 1965.

However, even when a technical program has been discontinued the staff involved continue to be consulted and asked for

advice and assistance by people who, for one reason or another, have a continuing need or interest.

Within technical areas of research, of course, changes of emphasis are continually occurring. These changes make themselves evident in the initiation and termination of specific projects. Termination frequently occurs by transfer to industry or to other government departments.

VI

ANNOTATED LIST OF INTRAMURAL
PROJECTS BY RESEARCH DIVISION

To accomplish its goals the NRC has one program covering all matters related to science and engineering. This program is supported by four main activities or sub-programs which, though separable in principle, are to some extent intermeshed. These are respectively, assistance to the universities, assistance to industry, general administration and promotion in support of research, and intramural research.

This Section lists the intramural projects of the Research Divisions which together make up the sub-program of intramural research. Included in the compilation, of course, are a number of projects in which the intramural activity interacts more or less strongly with the university and industrial programs.

The internal structure of most of the Divisions is made up of groups of research workers known unofficially as Sections. Usually a Section will be involved in one specific and identifiable part of the Division's activity, though it is not uncommon for several more or less loosely related projects to be going on within a given Section. Co-operative and complementary projects are often undertaken involving two or more Sections, either within the same Division or in different Divisions. The administrative structure in NRC is largely vertical, but the control and guidance of the scientific program is both vertical and horizontal.

DIVISION OF APPLIED CHEMISTRYBrief account of work carried out in laboratories

	<u>1963</u>	<u>1968</u>
<u>Analytical Chemistry</u>		
1. Atomic absorption spectroscopy		X
2. Emission spectroscopy of inorganic materials	X	X
3. Gas chromatographic and infrared analysis of organic mixtures	X	X
4. Analytical chemistry of thorium and associated rare earths	X	X
5. Ion exchange resins and spectrophotometric methods in inorganic analysis	X	
6. X-ray fluorescence inorganic analysis		X
7. Solid source mass spectrometry		X
<u>Applied Physical Chemistry (6)</u>		
1. Raw Fur Marking Ink	X	
2. Snow plow wax	X	
3. Forest fire hazard recorder (1)	X	X
4. Aircraft rain repellent	X	
<u>Chemical Engineering</u>		
1. Upgrading of impure water by reverse osmosis (7)	X	X
2. Concentration of maple sap		X
3. Concentration of rubber latex		X
4. Forest fire hazard meter (3)	X	X
5. Separation of suspended solids in liquids by inclined settling and spherical agglomeration	X	X

	<u>1963</u>	<u>1968</u>
6. Studies on physical and chemical properties of fluidized and spouted beds	X	
7. Solid state inorganic chemistry	X	
8. Separation of solids in packed fluidized beds		X
9. Preparation of single metal crystals		X

Colloid Chemistry

1. Dielectric properties of polar molecules	X	X
2. Applications of differential vapor pressure measurements	X	
3. Stability characteristics of suspensions	X	X
4. Concentration of iron minerals		X
5. Concentration of tin minerals	X	
6. Production of ball bearings	X	
7. Production of metal bird shot		X
8. Novel rapid printing methods		X
9. Spin lattice relaxation		X

Corrosion

1. Oxidation of iron	X	X
2. Oxidation of nickel		X
3. Electrochemistry of corrosion	X	X
4. Electron diffraction and microscopy	X	X
5. Metallography	X	X
6. Oxidation of iron-chromium alloys	X	
7. X-ray emission analysis		X

	<u>1963</u>	<u>1968</u>
<u>High Polymers</u>		
1. Ionic and polymerization mechanisms	X	
2. Characterization of solid polymers	X	
3. Lignin reinforcement of rubbers (4)	X	X
4. Molding and testing of rubbers (4)	X	X
5. Characterization of solid polymers		X
6. Micro structure of polymers		X
7. Synthesis of block copolymers		X
<u>High Pressure</u>		
1. Extension of steam tables	X	X
2. Accurate measurement of high pressures		X
3. Chemical kinetics at high pressure	X	
4. Properties of high pressure ices		X
5. Far infrared spectroscopy		X
<u>Hydrocarbon Chemistry (8)</u>		
1. Deterioration of fats and oils		X
2. Oxidation of liquid petroleum compounds		X
3. Reactions of phenols and amines with peroxy radicals		X
4. Organic synthesis		X
<u>Kinetics and Catalysis</u>		
1. Chemistry of atmospheric pollution (10)	X	X
2. Photochemistry of petroleum compounds		X
3. Catalytic processes in petroleum chemistry	X	X

	<u>1963</u>	<u>1968</u>
4. Electron spin resonance spectroscopy	X	X
5. Radiation damage in solids		X
<u>Metallurgical Chemistry</u>		
1. Physical chemistry of Silver	X	
2. Physical chemistry of Lithium-Indium		X
3. Physical chemistry of Silver-Gold	X	
4. Magnetic, electrical, thermal properties of metals and alloys	X	X
5. X-ray crystallography	X	X
6. Mass spectrometry	X	X
7. Upper atmosphere chemistry		X
8. Optical properties of metals	X	
9. Low temperature calorimetry		X
<u>Physical Organic Chemistry</u>		
1. Boron fluoride catalyzed polymerizations	X	X
2. Isomerization of olefins	X	
3. N. M. R. spectroscopy	X	X
4. Reaction of acids with olefins		X
5. Polymerization of ethylene		X
6. Complex catalytic systems		X
<u>Rubber (5)</u>		
1. Lignin rubber compounds (2)	X	X
2. Rubber base adhesive	X	
3. Evaluation of magnesium oxide in rubber	X	

<u>Textile Chemistry (9)</u>	<u>1963</u>	<u>1968</u>
1. Photo-degradation studies of cellulose	X	X
2. Microbiological deterioration	X	X
3. Mechanisms of degradation of fibre-forming molecules		X
4. Evaluation of textile properties and development of test methods	X	X
5. Serviceability of textiles	X	X
6. Degradation of poly propylene fibres		X

- (1) Transferred to Chemical Engineering
- (2) Transferred to High Polymer
- (3) Transferred from Applied Physical Chemistry
- (4) Transferred from Rubber
- (5) Section disbanded through divisional reorganization in 1964
- (6) Section disbanded through divisional reorganization in 1965
- (7) In collaboration with the City of Ottawa Pollution Control Centre, the renovation of sewage and hard waters is being studied as a sub-project
- (8) New section created in 1965 to strengthen divisional activity in petroleum science
- (9) Section reorganized with substantial realignment in activity in 1967
- (10) Increased activity in this long term project since 1966

DIVISION OF APPLIED PHYSICS

For purpose of administration the scientific staff of the division was divided into eight sections. These were:

1. Acoustics
2. Electricity and Mechanics
3. Heat & Solid State Physics
4. Instrumental Optics
5. Interferometry
6. Photogrammetric Research
7. Radiation Optics
8. X-Rays & Nuclear Radiations.

For an understanding of the activities of the division it is more useful to consider four areas into which most of the projects fall. The four areas overlap to a considerable extent and there exists a small amount of work which is not readily classified. These areas are:

- (A) Calibrations and measurements made at the request of Canadian industry, universities and government departments. In this work, the division supplies most of the secondary standards used by these organizations. This is a continuing task involving many hundreds of measurement reports per year.
- (B) Development of primary standards and the comparison of these standards with those of other leading industrial nations. This operation involves a large range of activities varying from the production and

improvement of physical apparatus which serve as the primary standards for quantities such as length, mass, time electrical units, or light intensity, to the determination of acceptable limits in the specification of quantities such as colour or noise level which depend upon human physiology and psychology.

(C) Assisting industry and producing new devices of interest to industry and government.

(D) Fundamental studies related to items, A, B and C.

The projects listed below are coded according to the section (1, 2 8) and the type of work (A, B, C, D) involved.

<u>All Sections - A:</u>		<u>1963</u>	<u>1968</u>
	Calibration of instruments.	X	X
1 B:	A study of the psychological effects of noise in enclosed spaces.	X	
1 B C:	Development of a probe microphone. (This device was patented and is now produced commercially).	X	
1 D:	Sound absorption by trees.	X	
1 C:	Development of a continuous flow liquid densimeter.	X	
1 D:	Absorption of sound waves in liquids.	X	X
1 C:	Reduction of noise in axial blowers.		X
1 D:	Studies of acoustic image formation.		X
1 C:	Statistical studies of traffic noise.		X
2 B:	Development of a primary standard of capacitance.	X	
2 B:	Design of a caesium clock. (This clock subsequently became the primary time standard).	X	

		<u>1963</u>	<u>1968</u>
2 B:	Improvement of the caesium clock and an international comparison of time standards.		X
2 C:	Development of a ship-borne fish-weighing machine. (This apparatus was patented and now is being produced commercially).	X	
2 A B:	Measurement of the variation in resistance of standard resistors which are dissipating power.		X
2 B:	Development of the hydrogen maser.		X
2 A:	Calibration of the reference standard of weight for the Department of Trade and Commerce as required by the Weights and Measures Act.		X
2 B:	International comparison of hardness measurement.		X
3 D:	Design of apparatus for determining thermal conductivity of metals at high temperature.	X	
3 D:	The measurement of the thermal conductivity of platinum at high temperature.		X
3 B:	Determination of fixed points on the temperature scale.	X	
3 B:	Design of high temperature furnaces and a study of the antimony melting point.		X
3 C:	Development of an instrument for measuring salinity, temperature and depth in ocean water.		X
3 A B:	Participation in an international test of thermocouple wire at high temperature.		X
3 B:	Determination of the reliability of high temperature measurements with an optical pyrometer.		X
3 D:	Electrical conductivity of ceramic materials at high temperature.		X
4 B C:	Construction of a new calibrator for air survey cameras. (This apparatus is now used to check every camera used in Canadian government surveys once a year).	X	

		<u>1963</u>	<u>1968</u>
4 B:	Evaluation of the various methods of determining photographic image sharpness.	X	
4 C:	Test of the resolution of films in air survey cameras.		X
5 B:	A study of the krypton emission line as a length standard.	X	
5 A:	Improvement of the apparatus for the calibration of end gauges. (A large number of these gauges are calibrated each year for industry and an apparatus was constructed to measure them in terms of the known wavelength of atomic emission lines).	X	
5 C:	A computer program was written which gives the design characteristics of multilayer thin film filters. (This program was subsequently sold to industry.)	X	
5 D:	An investigation of the processes occurring in rare gas discharges and in their afterglows.		X
5 B:	Development of a method of stabilizing a helium-neon laser.		X
5 C:	Development of a laser type range finder.		X
5 D:	Investigation of acoustic waves in liquids by means of light scattering.		X
5 D:	Investigation of the reflectance and other optical properties of semiconductors.		X
5 B:	Development of a CO ₂ laser suitable for length measurements.		X
5 C D:	A study of means of reducing the effects of diffraction on images.		X
6 C D:	Testing of the analytical plotter for map making. (This plotter is now being produced commercially outside of Canada).	X	
6 C:	Construction of a new model of the analytical plotter.		X

		<u>1963</u>	<u>1968</u>
6 D:	Photogrammetric studies of glacier movements and the production of glacier maps.	X	
6 D:	Use of photogrammetry in non-cartographic work. The study of water flow patterns and aircraft wing vibration were two particular studies.	X	
6 C:	A monocomparator, a device for the quick and accurate measurement of photographs, was designed. (This monocomparator will be produced commercially next year).	X	
6 B C D:	Development of the Sudbury test area.		X
6 C:	Development of analytical methods of correcting air survey photographs for mapping.		X
6 C:	Design and construction of a new type stereo orthophoto mapper.		X
6 C:	Development of an electrical method of measuring lengths and angles.		X
7 D:	An investigation of heterochromatic photometry was carried out with twenty observers and one hundred test lights.	X	
7 B:	The quality of natural daylight was determined in order to set standards for industrial colorimetry.	X	
7 B C:	Design of an artificial daylight source.		X
7 B C:	Progress was made on a method of setting colour tolerances in the industrial production of coloured materials.	X	
7 B C:	A study of the relative spectral sensitivity of photodiodes and an international intercomparison of the sensitivity.		X
7 C:	A study of the reflectivity of surfaces at various angles.		X
7 C:	Colour grading of maple syrup.		X

		<u>1963</u>	<u>1968</u>
8 B:	A comparison of the intensity of neutron and β -ray sources with those of other national laboratories was made in order to establish international standards.	X	
8 B D:	Studies were made of the performance of a β -ray spectrometer and it was used to investigate some nuclear reactions.	X	
8 D:	A number of nuclear reactions were studied with 14 MeV neutrons.	X	
8 B:	Development of a method of measuring the radioactivity of ^{125}I and ^{22}Na .		X
8 D:	Reactions of alkyl radicals produced by radiation.		X
8 B D:	Installation and testing of the linear electron accelerator and the positive ion accelerator.		X
8 D:	A study of (αn) and $(\alpha \gamma)$ reactions using the positive ion accelerator.		X
8 B:	Development of a calorimetric method of measuring absorbed dose of radiation.		X

ATLANTIC REGIONAL LABORATORY

This laboratory has been operating by a system whereby the scientists develop their own projects. It is a free enterprise system as far as the continuing scientific staff is concerned. As a result it is not possible to list a series of projects which started on a set date and were terminated on a set date. The following list of titles summarizes problems which have been investigated during the past five years, and most of these are still under study. Although the work has been mainly basic research it is expected to be of value in future practical applications. The titles below are grouped under headings which indicate the field in which application may occur, i. e. in industry, in medicine or in food production.

<u>A. Projects related to food production.</u>	<u>1963</u>	<u>1968</u>
1. Chemistry of seaweed polysaccharides.	X	-
2. Drying of seaweeds.	X	-
3. Systematics and ecology of marine algae.	X	X
4. Growth of phytoplankton organisms in pure culture.	X	X
5. Photosynthesis by marine algae.	X	X
6. Biochemistry and physiology of marine algae.	X	X
7. Cultivation of seaweeds. (1)	-	X
8. Production of toxic substances by fungi isolated from Nova Scotian pastures. (2)	-	X

(1) A new project on the breeding and selection of marine plants with enhanced commercial value.

(2) The possibility that these substances inhibit the growth of sheep on these pastures is being investigated.

	1963	1968
	X	X
9. Biosynthesis of lignin and related compounds.		
10. Metabolism of aromatic compounds by higher plants.	X	X
11. Biosynthesis of lichen substances.	-	X
12. Taxonomy and distribution of peat mosses.	X	X
<u>B. Projects related to medicine.</u>		
13. Chemistry of psychotomimetic compounds.	-	X
14. Chemistry of aminochromes and catecholamines.	-	X
15. Biosynthesis of antibiotics by actinomycetes.	X	X
16. Metabolic control of biosynthesis in fungi.	-	X
17. Spectroscopic studies on hydration of ribonucleic acids.	X	X
<u>C. Projects related to chemical industry.</u>		
18. Reactions of liquid silicates at high temperatures.	-	X
19. Cryoscopic studies of molten salts at high temperatures.	X	X
20. Kinetics of the decarbonization of liquid iron-carbon alloys.	X	X
21. Kinetics of the desulphurization of iron-sulphur alloys.	X	X
22. Hydrogen bonding in ice and water.	-	X
23. Electrochemical studies on inorganic compounds at high temperatures.	X	X
24. Synthesis of aromatic compounds by the Diels-Alder process.	-	X
25. Temperature effects in the substitution reactions of aromatic compounds.	-	X
26. Relative reactivities of the hydroxyl groups of carbohydrates.	X	X
27. Determination of gases in metals by isotopic dilution.	X	-
28. Determination of the structures of natural products by spectroscopic methods, (infrared, nuclear magnetic resonance and mass spectrometry).	X	X

BIOCHEMISTRY AND MOLECULAR BIOLOGY

This is a new division, formed in 1968, to bring an interdisciplinary approach to the study of some important biochemical and biological problems. In keeping with this approach the division contains organic chemists, physical chemists, biochemists, and physicists. These scientists were formerly in the division of Biosciences, Pure Chemistry, and Pure Physics and were brought together on the basis of their common interest in studying biological systems at the molecular level.

The projects listed below for 1963 were done at that time by the scientists who are presently in the new division.

	<u>1963</u>	<u>1968</u>
(a) <u>Carbohydrate Chemistry</u>		
(1) Lipopolysaccharides of <u>Serratia marcescens</u>	X	
(2) The polysaccharides of birch sap	X	
(3) The extracellular glucan from <u>Pullularin pullulans</u>	X	
(4) Methanolysis reactions of pentoses	X	
(5) Synthesis of <u>O</u> -benzyl monosaccharides	X	
(B) <u>Immunochemistry of Carbohydrates</u>		
(1) The structures of antigenic lipopolysaccharides	X	X
(2) Polysaccharides from dermatophytes	X	X
(3) Antigenic glycopeptides from dermatophytes		X
(4) Cell-wall polysaccharides from <u>Penicilliae</u>		X
(5) Mannans from pathogenic yeasts		X

	<u>1963</u>	<u>1968</u>
(6) Synthetic antigens from carbohydrates		X
(C) <u>Enzymology</u>		
(1) The chemistry of bacterial cell walls	X	
(2) Proteolytic enzymes from fungi	X	
(3) Proteolytic enzymes from <u>E. coli</u>	X	
(4) Polysaccharide hydrolases from fungi	X	
(5) Polysaccharide hydrolases from snails	X	
(6) Proteolytic enzymes from myxobacteria		X
(7) Physical chemistry of enzymesubstrate reactions		X
(D) <u>Cell Biochemistry and Biophysics</u>		
(1) Characterization of muscle protein	X	
(2) Disruption of mitochondria by freezing	X	
(3) Physical chemistry of hemoglobin and lipoproteins	X	
(4) The role of the cell nucleus in cell differentiation		X
(5) The role of ribosomes in synthesis of cell-protein		X
(6) Control of protein synthesis in replicating cells		X
(7) The structure and function of cell membranes		X
(8) Biological fibre formation in cell-walls	X	X
(9) Syntheses of nucleic acids		X
(10) Conformational changes in nucleic acids		X

	<u>1963</u>	<u>1968</u>
(E) <u>X-ray Diffraction</u>		
(1) The structure of hetisine hydrobromide	X	
(2) The structure of delcosine	X	
(3) The crystal structures of minerals	X	
(4) The structure of azabicyclo (3.1.0) hexanes	X	
(5) The structure of opium alkaloids		X
(6) The structures of anilides		X
(7) The crystal structure of myxin		X
(8) The structures of alkaloids	X	X
(9) The structure of Bence-Jones protein		X
(10) The structure of haptoglobin		X
(F) <u>Organic Chemistry</u>		
(1) Structures of alkaloids	X	X
(2) The chemistry of myxin		X
(3) Syntheses of terpenes		X
(4) Synthesis of steroids		X
(5) Deamination of α -amino ketones	X	X
(6) Synthesis of porphyrins	X	X
(7) Degradation products of chlorophylls	X	X

DIVISION OF BIOLOGYMajor Projects - 1963 and 1968

In 1964 the name 'Division of Applied Biology' was changed to 'Division of Biosciences'. When the Director of the Biosciences Division retired at the end of June 1968, a reorganization of NRC's biology programme began. The Biosciences and Radiation Biology Divisions were regrouped as follows:

Biology, consisting of two-thirds of the old Biosciences Division and the

Division of Radiation Biology.

Biochemistry and Molecular Biology, consisting of one-third of the old

Biosciences Division, the Organic Chemistry Section of the

Division of Pure Chemistry, as well as X-ray crystallography

groups from Pure Chemistry and Pure Physics.

Following this reorganization some of the previous research programmes were terminated and new interdisciplinary projects are being initiated.

	<u>1963</u>	<u>1968</u>
<u>Food Storage and Processing</u>		
1. Studies of the quality of frozen poultry	X	
2. Research into the effects of pre- and post-slaughter treatment on beef quality		X
3. Application of the jacketed cold storage principle to refrigerated trucks	X	
4. Assessment of optimum cold storage conditions for Canadian fruits and vegetables	X	

	<u>1963</u>	<u>1968</u>
5. Investigations into the effects of processing procedures and storage conditions on the contamination of poultry and beef by micro-organisms	X	X
6. Studies of milk proteins and their reactions with other components of milk	X	
7. Assessment of the effects of source, season and cold storage on the quality of eggs	X	

Chemistry of Natural Products

1. Correlation of chemical structure and antigenic properties of microbial polysaccharides	X	
2. The isolation of plant phospholipids and studies of their chemistry and biosynthesis	X	
3. A taxonomic study of the lipids of micro-organisms	X	
4. Chemical studies of the proteins and lipoproteins of avian eggs and their changes during incubation	X	
5. Determination of amino acid sequences in horse haemoglobin	X	

Biometrics

1. A statistical study of the correlation of the protein content of Canadian wheat with the region and weather conditions of its growth	X	
2. Automatic numerical processing of experimental data from continuous recording devices		X
3. Fundamental studies of methodology in multi-variate statistical analysis		X
4. Computer simulation of cell proliferation and its change with time		X

	<u>1963</u>	<u>1968</u>
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Animal Physiology

- | | | | |
|----|--|---|---|
| 1. | Studies of the physiological adaptation of animals to cold and season | X | X |
| 2. | Measurements of function in birds during flight | X | |
| 3. | Investigation of the toxicity and metabolism of chlorinated hydrocarbons in relation to environmental stress | | X |

Plant Physiology

- | | | | |
|----|---|---|---|
| 1. | Studies of photosynthetic pigments and reactions in bacteria and algae | X | |
| 2. | Measurement of the amount and velocity of sucrose translocation by the use of radio-active tracers in higher plants | X | X |
| 3. | Correlation of the chemical properties and toxicity of a poison produced by blue-green algae | X | X |

Cell Biology

- | | | |
|----|--|---|
| 1. | Studies of the physics and chemistry of cellulose microfibrils produced by a bacterium | X |
| 2. | An analysis of the biochemical and biophysical processes in the differentiation of plant cells | X |
| 3. | Observations on the mechanism of protein synthesis by ribosomes in halophilic bacteria | X |

Microbiology

- | | | |
|----|---|---|
| 1. | Studies of the morphology and metabolism of halophilic (salt-loving) and psychrophilic (cold-loving) bacteria | X |
| 2. | Development of a continuous process of the production of citric acid from beet sugar molasses | X |

	<u>1963</u>	<u>1968</u>
3. Maintenance of the NRC Culture Collection and associated taxonomic studies	X	X

Radiation Biology

1. Studies of cell proliferation in rat thymus and bone marrow as well as the effects on this process of ionizing radiation and various metabolites and hormones		X
2. Measurements of the metabolism of radioactive materials in rats		X
3. Investigations of the chemical and physical effects of radiations on constituents of living cells		X

DIVISION OF BUILDING RESEARCH
FOR 1963 AND 1968

The work of the Division of Building Research is divided into two areas -

- a. Building Science: provision of a laboratory research service for the Construction Industry of Canada;
- b. Building Practice: assistance in the application of research results and with problems arising in the field.

Within these two areas the following programmes are carried on: -

A. BUILDING SCIENCE -

Building Materials: studies of physical and chemical properties of materials and their relation to performance in different environments.

Building Services: studies of environmental conditions in buildings; characteristics of exterior walls, roofs, windows and doors in respect of passage of heat, water vapour, air and rain; and the performance of mechanical services.

Building Structures: studies of the strength and deformation of buildings and civil engineering structures and the loads to which they are subjected.

Building Physics: application of physics to building problems, particularly vibration and acoustics.

Fire Research: reduction of hazard and improved methods of extinguishment of fire.

Snow and Ice and Climate: studies of the properties of snow, ice and snow and ice covers, particularly in relation to design, construction and operation of various structures. Climate as it affects construction and buildings.

Soil Mechanics and Northern Studies: improvement of engineering design and construction techniques in which the performance of soil is an important consideration. Problems of northern terrain in relation to construction.

B. BUILDING PRACTICE -

Construction: liaison with the construction industry; studies of the performance of buildings; answering technical inquiries, particularly by correlating information from the building science programmes of the Division and from scientific and technical literature.

Housing: construction, performance and economics of housing, assistance to Central Mortgage and Housing Corporation in programme of construction under the National Housing Act.

Codes Secretariat: provision of secretarial services for the Associate Committees on the National Building Code and the National Fire Code of Canada.

Library: library service in the fields of interest of the Division's programmes and the construction industry as a whole.

Publications: processing and distribution of technical information gained by Divisional studies.

Regional Stations - Atlantic, Prairie and British Columbia:

provision of an information service for those concerned with building in these areas and carrying out research on construction problems peculiar to their regions.

The following is a list of research projects being carried on under the above programs at the beginning and end of the five-year period, 1963 - 1968 :-

<u>BUILDING MATERIALS -</u>	<u>In process</u> <u>1963</u>	<u>In process</u> <u>1968</u>
To evaluate the field performance of several types of paints on different wood substrates.	X	
To evaluate the field performance of 72 different clear coatings on wood siding.	X	..
Weathering of asphalts used in roof membranes.	X	
Effect of composition and design of bituminous roofing membranes upon their mechanical behaviour particularly at low temperatures.	X	
Study of the nature of the strength in gypsum plaster and hydrated cement.	X	
Study of changes in strength and elastic modulus of hydrated cement due to changes in moisture content from dry to saturated conditions.	X	

	In process 1963	In process 1968
Physical, mechanical and chemical changes in hydrated cement and lime resulting from carbonation and ageing.	X	
Use of organic surface active agents, oleic acid and silicones, for reducing the drying shrinkage of hydrated cement.	X	
Measurement of atmospheric factors of time of wetness and pollution by SO_2 and chlorides and the correlation of these with rates of metal corrosion - Joint project Canada and U. S. A.	X	
Effect of different weather factors of wetting and sunlight on cracking and peeling of house paints.	X	X
Study of basic mechanical properties and gas and vapour permeability of clear coatings.	X	X
Evaluation of long term performance of coated fuel drums for use in the north.	X	X
Evaluation of field performance of paints on steel substrates at eight corrosion sites across Canada.	X	X
Evaluation of field performance of different plastics at four sites in Canada.	X	X
Study of the basic reactions involved in the degradation of plastics.	X	X
Measurement of rate and extent of joint movement in buildings to which sealants are subjected.	X	X
Effect of temperature and weathering on the mechanical and adhesive properties of a number of types of sealants.	X	X
Dimensional changes of cement paste resulting from wetting and drying.	X	X
Physical, mechanical and mineralogical changes in hydrated cement resulting from organic chemical admixtures.	X	X

	<u>In process 1963</u>	<u>In process 1968</u>
Effect of freezing on durability and stability of hydrated cement and other porous materials.	X	X
Destructive reaction of some dolomitic limestone aggregate with alkali in concrete.	X	X
The role of microstructure and mineralogical composition of leda clay on its mechanical behaviour.	X	X
Measurement of atmospheric corrosion of various architectural metals at eight sites across Canada.	X	X
The wetting and freezing of masonry walls, effect of orientation and resulting lack of durability.	X	X
Deterioration of concrete in the Maritimes associated with certain aggregates.	X	X
Deterioration of concrete on the Prairies resulting from high sulphate content in soils.	X	X
Instability of brick masonry due to certain combinations of different bricks and mortars.	X	X
<u>BUILDING SERVICES -</u>		
Convection heat loss in mineral wool insulation.	X	
Performance of masonry chimneys.	X	
Thermal performance of insulated masonry walls.	X	
Annual humidity variations in buildings.	X	
Household emergency shelter studies.	X	
Temperature and ventilation in underground railways.	X	

	<u>In process 1963</u>	<u>In process 1968</u>
Effects of room illumination systems on heating and cooling requirements.	X	
Air and rain leakage through windows and curtain wall joints.	X	X
Air leakage in buildings.	X	X
Weather data for air-conditioning design.	X	X
Heat transfer between engineering structures and the ground.	X	X
Computer methods for calculating heating and cooling requirements.	X	X
Water vapour permeability of materials.	X	X
Heat flow in moist materials.	X	X
Evaluation procedures for sealed double-glazing units.	X	X
Condensation on surfaces of double windows.	X	X
Factors affecting breakage of window glass.		X
Strain measurements in perforated breakwater at Baie Comeau.	X	
Snow loads on roofs.	X	X
Wind loads on structures.	X	X
Wind pressure measurements on full-scale buildings.	X	X

	<u>In process 1963</u>	<u>In process 1968</u>
Precast concrete studies.	X	X
Strength of wood frame houses.	X	X
Strain gauges in concrete.	X	X
Assistance to NBC, CSA, ACI and CIB Committees in preparation of codes and standards.	X	X
The probability of failure in structures and factors of safety.		X
<u>BUILDING PHYSICS -</u>		
Noise and vibration TCC Subway	X	
Development of impact test for sound transmission through floors.	X	X
Acoustical test methods.	X	X
Development of sound insulation criteria.	X	X
Reverberation rooms and sound absorption measurements.	X	X
Earthquake engineering.	X	X
Computer simulation of buildings and their seismic response.	X	X
Calculation and measurement of building vibration modes.	X	X
Sound insulation - field tests and surveys.	X	X
Building and ground vibrations produced by blasting and by construction equipment.	X	X
Theoretical and experimental studies of sound transmission through walls.		X
Environmental vibrations in laboratories.		X

In process 1963	In process 1968
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FIRE RESEARCH -

Fire behaviour in high buildings and its implications for design.

X	X
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Statistical analysis of deaths due to fire in Ontario.

X	X
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Effect of lining materials on the spread of fire in corridors.

X	X
---	---

Properties of building materials from the viewpoint of their behaviour in fire.

X	X
---	---

Thermal and structural performance of building elements in actual or simulated fires.

X	X
---	---

Extinguishment of building fires by inert gas and high expansion foams.

X	X
---	---

Thermal decomposition products of plastics.

X	X
---	---

Correlation of flame spread tests and accumulation of flame spread data on Canadian building materials.

X	X
---	---

International Co-operative Research Project : The development of fire in an enclosure.

X	X
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SNOW AND ICE AND CLIMATE -

A study of the formation, growth and break-up of ice covers on lakes and rivers. Particular attention is being given to the information required for the design, construction and operation of engineering works; and to methods of predicting and controlling the formation of frazil ice.

X	X
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The establishment of information on the forces that can be exerted by ice required for the design of structures such as dams, bridge piers, wharfs and ice breakers.

X	X
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	<u>In process 1963</u>	<u>In process 1968</u>
A study of the bearing capacity of ice covers on lakes and rivers.	X	X
The establishment of the information on the elastic, plastic and strength properties of ice required for engineering problems such as estimating the forces that ice can exert and the bearing capacity of ice covers.	X	X
Field survey of icing loads that can occur on structures such as electrical transmission towers, microwave towers and antennae (with assistance of C. S. A.).	X	X
A study of avalanches and the factors that control their occurrence and characteristics such as size and speed. Particular attention is being given to establishing the information required for the design of avalanche defense works and to field observations on the performance of constructed defense works such as those on the Trans-Canada Highway in the Rogers Pass area of B. C.	X	X
A study of snow removal and control of ice on roads and airports. The principal activity for this project has been assisting in the preparation of a manual on Urban Snow Removal.	X	X
Field study of factors affecting design, construction and winter maintenance in areas subject to deep snow; for example, the dependence of depth of snow on the ground on altitude in mountainous areas, the locating of buildings to minimize problems due to drifting snow and the effect of deep snow on the performance of roofs and walls of buildings.	X	X
A study of the heat and moisture exchange between the atmosphere and the ground and water surfaces. Particular attention is being given to the dependence of ground temperature on this exchange and on the snow cover.	X	X

<u>SOIL MECHANICS AND NORTHERN STUDIES -</u>	<u>In process 1963</u>	<u>In process 1968</u>
Earth pressure measurements to improve design criteria for large tunnels in clay.	X	
Subsurface exploration and temperature measurements to assess the thawing effect of surface water on permafrost.	X	
The frost heaving process in soils.	X	X
Fundamental behaviour of sensitive clays.	X	X
Laboratory studies and field observations of foundations on compressible clays.	X	X
Strength characteristics and application to stability problems of sensitive clays.	X	X
Study of swelling and shrinking clays and their effect on shallow foundations.	X	X
Engineering properties of peat and its field behaviour.	X	X
Mapping the distribution of permafrost in Canada and study of factors affecting its occurrence.	X	X
Design and performance of pile foundations in permafrost.	X	X
Field assessment of dyke design and performance in relation to Hydro development in permafrost regions.	X	X
Field behaviour of foundations in frost heaving soils.		X
Thermal insulation of roads with foamed plastic.		X
Measurement of nature and magnitude of loads in large piles due to compressive clay subsoils.		X
Field studies of transmission line anchorages in permafrost.		X
Laboratory study of strength of frozen soil in relation to temperature and loading conditions.		X

<u>CONSTRUCTION -</u>	<u>In process</u> <u>1963</u>	<u>In process</u> <u>1968</u>
Study and promotion of good practices in winter building.	X	X
Investigation of roofing failures and promotion of improved practices.	X	X
Investigation of wall and window failures and the development and promotion of improved design details.	X	X
Promotion of modular co-ordination.	X	X
<u>HOUSING -</u>		
Development of standard roof truss designs for houses.	X	
Potential of plastics as major components for house structures.	X	
Present and potential roles of prefabrication in Canadian housing - first phase.	X	
Prediction of wood roof truss strength and deflection.	X	
Survey of the maintenance records of public housing in Ontario.	X	X
Assessment of slab-on-ground foundation design and construction methods.	X	X
Observations of NHBA Experimental houses.	X	X
Condensation in house roofs in Inuvik.	X	X
Methods of evaluation of structural adhesives for enclosure panels.	X	X
Cost study of house painting.		X
Water pick-up of house footing drain tile (jointly with OWRC).		X
System building in Europe.		X

REGIONAL STATIONS -

In process 1963	In process 1968
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ATLANTIC -

Paint studies - performance of paint on wood sidings.

X

X

Masonry studies, including regional field tests of moisture content and temperature levels, dimensional change measurements and long-terms freeze-thaw tests.

X

X

Performance of reinforced concrete structures in sea water.

X

X

Masonry staining and cleaning and use of protective coatings.

X

X

Comparison of local outdoor curing and laboratory curing of cement-lime mortars.

X

X

PRAIRIE -

Prairie environment evaluation, including meteorological records, "indoor" climate studies, snow loads on roofs and ground temperatures.

X

X

Performance of building materials and components in Prairie weather conditions.

X

X

Mechanical equipment for humidification, ventilation and heating of buildings.

X

X

Ground movements in local clay soils.

X

X

Identification and mapping of sulphate bearing soils and field studies of sulphate attack on concrete.

X

X

DIVISION OF MECHANICAL ENGINEERING

It is natural that a substantial volume of the work in an engineering organization like the Division of Mechanical Engineering should consist in short term pieces of work for industry, but the competence on which these tasks rest is set out in the lists below. As marked, certain of the projects listed were active in 1963 and certain in 1968, and a few over the whole interval of intervening time.

List of Major Projects - 1963 and 1968

	<u>1963</u>	<u>1968</u>
MECHANICS		
<u>Analysis</u>		
1. Simulation of aircraft flight, of fluid mechanical problems and of control systems	X	X
2. Random signal analysis	X	X
3. Study of air turbulence, water waves, structural vibrations, and biological signals	X	
4. Analysis of gas pipeline flow, control and optimization of compressors		X
5. Simulation of reciprocating engine dynamics		X
6. Design of computer facility for engineering design studies	X	X
7. Study of topics in control theory	X	X
<u>Instrument</u>		
1. Tide control for model of Fraser River estuary	X	
2. Digital control and data logging system for St. Lawrence River tidal model		X

	<u>1963</u>	<u>1968</u>
3. System for measuring and recording wave direction in open bodies of water		X
4. Development of non-contacting tidal wave amplitude measuring device		X
5. Development of a converter for Department of Energy, Mines and Resources, to convert analog tide records to punched cards	X	
6. Adaptation of a frame card processor camera for transposing corrected Bathythermograph grid records and microfilm inserts in punched cards	X	
7. System for underwater photography of full scale ships' propellers operating under cavitating conditions	X	
8. Six-component balance for ship model towing tank	X	
9. Camera system for recording ship model position and heading during manoeuvring tests	X	
10. Adaptation of 3-axis gyro stabilized platform for geophysical measurements at sea	X	
11. Development of memory gust recorder for aircraft use	X	
12. Redesign of memory gust recorder for use in supersonic transport aircraft		X
13. Development of surgical instruments and aids to surgery	X	X
14. Study, design and development of powered lower limb prostheses	X	X
15. Investigation of practicability of artificial valves in biological systems		X
16. Computer simulation and field studies of longitudinal oscillations in long trains, with particular emphasis on the effects of new draft gear design	X	X

		<u>1963</u>	<u>1968</u>
17.	Development of techniques for measuring flange forces on railway freight car wheels under actual operating conditions	X	
18.	Reed-type statistical impact recorder for railway freight car use	X	
19.	Development of new techniques for measuring shock and vibration environment in freight cars with particular emphasis on lading damage		X
20.	Study of damage to newsprint shipped by rail		X
21.	Accelerometer tester for calibration of counting type accelerometers used on board RCAF aircraft	X	
22.	Investigation of pick-off's for fluid gyros		X
23.	Consideration of airport noise problems		X

Engineering Dynamics

1.	Investigation of the contact fatigue life of steel gears	X	
2.	Dynamical behaviour of spur and helical gears	X	X
3.	Examination of the effects of tooth profile errors and rim flexibility on the load distribution on gear teeth	"	X
4.	Examination of the effect of shaft alignment on gear tooth loading		X

Control Systems

1.	Investigation of the dynamic characteristics of the transonic section of the transonic 5' x 5' wind tunnel	X	
2.	Development of a dynamic pressure control system for a low speed wind tunnel	X	
3.	Investigation of the stability of linear systems with time-varying parameters	X	

1963 1968

Industrial Control Problems

- | | | |
|----|--|---|
| 1. | Investigation of industrial systems applications of fluidic circuits, | X |
| 2. | In collaboration with the Department of Energy, Mines and Resources, and investigation of the process dynamics and control characteristics of an electric arc furnace for processing iron ore. | X |
| 3. | Dynamic modelling of electric arc and oxygen steel-making processes. | X |
| 4. | Investigation of the process dynamics and control characteristics of a copper converter. | X |

Large Systems Studies

- | | | |
|----|---|---|
| 1. | Investigation of the possible influence of fresh water outflow on climate. | X |
| 2. | Investigation of the properties and economics of large information systems. | X |

HUMAN ENGINEERING

- | | | |
|----|--|---|
| 1. | Development of a moving base simulator for human operator studies. | X |
| 2. | A general programme of research and development in the human factors engineering field that includes the following: | X |
| | Investigation of the control characteristics of the human operator and the basic phenomena underlying tracking performance. | X |
| | Investigation of the nature of sensory interaction in human perceptual-motor performance. | X |
| | Investigation of the factors involved in the presentation and processing of information, particularly in relation to simulator design. | X |

19631968

BIOLOGICAL ENGINEERING

- | | | |
|----|---|---|
| 1. | Development of an analog correlator for processing EEG signals. | X |
| 2. | Development of an arterial catheter with a self-seeking tip. | X |
| 3. | Investigation of neuromuscular control systems - Part I - Inhibition of nerve conduction. | X |
| 4. | A blood heat exchanger has been developed for selective brain cooling to permit radical neurosurgery. Clinical application of this equipment has been accomplished. | X |
| 4. | Various auxiliary medical engineering equipment originally designed for the heat exchanger has been further developed for other surgical applications. | X |
| 6. | A general programme of research and development in the biological engineering field that includes the following: | X |
| | Investigation of the implementation of feedback control in living organisms. | X |
| | Investigation of data transmission processes, with particular reference to nerve conduction characteristics. | X |
| | Investigation of auditory methods of monitoring electro-physiological signals in general and the electroencephalograph in particular. | X |
| | Development of depth probes for the study of electrical activity in the deep structures of the human brain. | X |
| | Development of stereo-taxic and other apparatus for neurosurgical procedures. | X |
| | Development of a phase memory filter for electroencephalograph studies. | X |

	<u>1963</u>	<u>1968</u>
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Pattern Recognition

- | | |
|--|---|
| 1. Investigation of the fundamentals of pattern recognition. | X |
| 2. Development of techniques for the identification of biological cell populations, fingerprints, etc. | X |

Bird Dispersal by Microwave Radiation

- | | |
|---|---|
| 1. Investigation of the effect of low-intensity microwave radiation on the behaviour of birds on the ground and in the air, to determine the practicability of using microwave radiation for dispersing birds on airfields and from the flight path of an aircraft. | X |
|---|---|

HYDRODYNAMICS

- | | | |
|---|---|---|
| 1. Harbour investigations of Rustico Harbour, Prince Edward Island and Chandler Harbour, Quebec. | X | |
| 2. Perforated breakwater development for Baie Comeau. | X | |
| 3. Tidal hydraulic investigation of the Fraser River estuary. | X | |
| 4. Water temperature measurements and ice movement in the St. Lawrence River and estimation of the heat budget before and during freeze-up. | X | X |
| 5. Investigation of air bubblers for the prevention and melting of ice covers in fresh or sea water environments. | X | |
| 6. St. Lawrence Ship Channel Montreal to Father Point hydraulic and mathematical model study for improving navigation conditions. | | X |
| 7. Wave direction study: To examine the correlation between wind direction and direction of wave propagation. | | X |

Special Committee

	<u>1963</u>	<u>1968</u>
8. Wave interaction: To study non-linear interactions in waves.		X
9. Cobourg breakwater: Study of forces on submerged breakwater.		X
10. Wave climate study: To find statistical distribution of wave height and period in Gulf of St. Lawrence.		X

Naval Architecture

1. Various hull and propeller design work for the Royal Canadian Navy, the Department of Transport, the Department of Fisheries, the Department of Industry, and the Department of Energy, Mines and Resources.	X
2. Various work has been done on partially and fully cavitating hydrofoils.	X
3. Work for industry on speed measuring logs.	X
4. Sea keeping experiments for ships rolling in a beam sea with particular emphasis on the design of new steel ships for the Department of Transport for use in the Pacific Ocean.	X

Wave Study and Ship Strength

1. Rough water trials were continued in the Gulf of St. Lawrence and the Great Lakes on bulk carriers. A large amount of computer analysis was completed.	X
2. Model bending moment responses in regular waves were used to compute ship responses in irregular short-crested seas for three Great Lakes bulk carriers on which much corresponding information has been acquired at sea.	X
3. Further work was carried out in improving existing methods in developing new electronic and computer techniques. A number of sea records were processed.	X

	<u>1963</u>	<u>1968</u>
<u>Fishing Vessels</u>		
1. Some existing model seakeeping test data were prepared for a more generalized treatment by computer.		X
<u>Dredging</u>		
1. A study was made of the relationships between dredges and their associated dump barges, to establish a basis for optimizing the design of the latter.		X
<u>Catamarans</u>		
1. An extensive series of model tests of a catamaran buoy vessel with asymmetric hulls at different spacings was completed.		X
2. Three models and a number of modifications were tested in smooth water and in waves, one with Voigt-Schneider propulsion to meet extreme requirements of manoeuvrability.		X
3. Propulsion, measurement, and seakeeping experiments with two models combined.		X
<u>Tankers</u>		
1. Two models were tested for resistance and propulsion.		X
<u>Cavitation</u>		
1. Alternative blade designs for a controllable-pitch propeller were tested in the cavitation tunnel.		X
<u>Towed Bodies</u>		
1. Model tests to investigate the dynamic depression of towed echo-sounder bodies were initiated.		X
2. Two towed bodies were tested at high speeds in salt water behind a hydrofoil vessel.		X

	<u>1963</u>	<u>1968</u>
<u>Hydrofoils</u>		
1. Hull tests to relatively high speeds on a model of a hydrofoil test vehicle were undertaken.		X
<u>Plankton Sampler</u>		
1. A plankton sampler was tested in the towing tank to investigate the pressure distribution and velocities internally and externally.		X
<u>Twin-Screw Yacht</u>		
1. A model of a 120-ft. yacht was tested for resistance and propulsion, and in head and stern waves.		X
<u>Electro-Magnetic Log</u>		
1. An electro-magnetic log housing was tested in the cavitation tunnel to establish the cavitation characteristics of the housing.		X
<u>Cable Fairings</u>		
1. Drag measurements made on various configurations.		X
<u>Helicopter Floats</u>		
1. Models prepared for hydrodynamic force and moment measurements.		X

	<u>1963</u>	<u>1968</u>
<u>Ducted Propulsion</u>		
1. Propulsion tests carried out on a bulk carrier installation.		X
<u>Air Cushion Vehicles</u>		
1. Model tests commenced on a twin axial impeller rigid side wall combined lift and propulsion system.		X
<u>Shallow Draft Ferry</u>		
1. New Manoeuvring device fitted on a model and tests successfully completed.		X
<u>Strut Mounted Submarine Vessel</u>		
1. Design and manufacture completed. Hovercraft installation trials nearing completion.		X
<u>Weather ship Seakeeping</u>		
1. Various model anti-pitching fins and bulbs made ready for testing.		X
Various investigations were done during 1968 for 19 different companies.		X

THERMODYNAMICS

Locomotive EnginesReciprocating Engines

- | | |
|---|---|
| 1. Investigation of the use of crude oils in locomotive diesel engines with particular emphasis on "souping" during prolonged idling. | X |
| 2. Investigation of the phenomenon of adhesive wear (galling) in locomotive diesel engines as encountered with current lubricating oils | X |
| 3. Investigation of combustion and control problems in free piston gasifier engines by experiment and hybrid computer analysis. | X |

	<u>1963</u>	<u>1968</u>
<u>Gas Turbines</u>		
1. Investigation of the transient response characteristics of gas turbine machinery suitable for locomotive use.	X	X
2. Investigation of the torque characteristics and efficiency of gas turbines designed for traction use.	X	
3. Experimental assessment of partial admission traction turbine.	X	
4. Examination of the braking characteristics of a free gas turbine having variable stator geometry.	X	
5. Analytical and experimental study of thermosyphon elements (heat pipe) for heat exchanger applications in gas turbine power plants.		X
<u>Centrifugal Compressors</u>		
1. Investigation of the flow in the rotors of centrifugal compressors and pumps.	X	X
2. Work on an hydraulically operated snowplow gate to reduce the blocking of laneways by passing snowplows.	X	
<u>Engines for Vertical Take-Off Aircraft</u>		
1. Investigation of lifting turbofans to be employed with widely available aircraft turbojet engines, to give VTOL capability to otherwise conventional aircraft.	X	
2. Investigation of fans for vertical take-off aircraft under transverse flow conditions corresponding to the transition from hovering to normal flight.		X
3. Investigation of noise phenomena peculiar to aircraft lifting fans.		X
4. VTOL aircraft propulsion tunnel near completion.	X	

	<u>1963</u>	<u>1968</u>
5. The effect of crossflow on the performance of various aerodynamic compressor and fan intakes.		X
6. The effect of flow distortion on the performance of fans and compressors.		X
7. Experimental studies on the effect of partial admission on the overall thrust efficiency of a turbine-fan combination.		X
8. Experimental examination and quantitative evaluation of the effect of flow distortion on the performance and pressure losses in gas turbine ducting components such as diffusers, annuli and bends.		X
9. Aerodynamic performance of rearward facing inlets for VTOL engine to provide safety from bird ingestion.		X

Aircraft Propulsion

1. Investigation of the aerodynamic and mechanical performance of small axial compressor arrangements.		X
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General Investigation of Thermally Ionized Gases

1. Theoretical and experimental studies on the production of high temperatures using electrical discharge to generate a <u>converging cylindrical</u> shock wave in gases at low pressures.	X	
2. Temperature measurement of gases at very high temperatures (4000 to 40,000°K) using spectroscopic techniques.	X	
3. High speed streak camera development for examining transient phenomena in shock tubes.	X	
4. Calculation of electrical conductivity of partially ionized gases from theoretical considerations and experimental verification.	X	

	<u>1963</u>	<u>1968</u>
5. The effect of seeding gases with alkaline metals on the conductivity of a hot gas.	X	
6. Development of diagnostic methods for measuring temperature and conductivity of gases at very high temperatures.	X	
7. Theoretical and experimental studies on the production of high temperatures at high pressures using spherical shock waves produced by explosive shells.		X
8. Development of small probes capable of measuring temperature and conductivity of gases in the region of 4000 to 50,000°K.		X
9. Development of interferometric techniques for measurement of transient temperature, conductivity and particle density of a gas at the centre of implosions which last for only a few micro seconds but reach extreme values necessary for thermonuclear reactions.		X
10. Experimental and theoretical studies on the interaction between a thermally ionized gas and magnetic and electric field.		X

Miscellaneous Engineering

1. Flow losses in large industrial hydraulic valves.	X	
2. Pressure losses in large flues in smelters and metal refineries.	X	
3. Combustion studies for industrial gas turbine application.	X	
4. Theoretical and experimental research on hydrostatic air bearings.	X	X
5. Experimental examination and analysis of shaft whirling phenomenon and of techniques for permitting operation through critical speed ranges.	X	X

	<u>1963</u>	<u>1968</u>
6. Experimental assessment of a small auxiliary gas turbine at altitude conditions.		X
7. Experimental assessment of hydraulic pumps and seals designed for heavy water circulation in power reactors.		X
8. Experimental assessment of compressors designed for gas transmission line service.		X
9. Experimental and analytical examination of the thermosyphon for use in melting ice from navigation buoys during the winter by utilization of heat from water at lower levels.		X
10. Experimental examination and assessment of the thermosyphon as a means of ensuring that permafrost conditions will remain even where ground cover has been disturbed (for example, near transmission towers leading from northern power development sites).		X
11. Design, development and experimental assessment of heating equipment for laying continuous rails at proper stress levels for optimum roadbed maintenance.		X

Cold Weather Work

Aircraft Icing and De-Icing

1. A variety of de-icing experiments have been done in the low speed icing wind tunnel on the following:		
aircraft windshields	X	
wings	X	X
helicopter engine inlet	X	X
2. Investigations have been carried out on failure of pilot tubes in icing, ice crystal and snow conditions in the high speed icing tunnel.		X
3. Anti-icing and de-icing experiments have been conducted on helicopters in the helicopter icing spray rig.	X	X

	<u>1963</u>	<u>1968</u>
<u>Icing of Ships at Sea</u>		
1. Experiments have been conducted on icing of sections representative of ship spars, booms and masts under conditions simulating ship icing.		X
2. Equipment has been set up to determine the adhesive strength of ice to various substrates in order to evaluate various ice-phobic surfaces.		X

Railway Climatic Problems

1. The cause of severe air brake leakage at low temperatures was investigated and corrective action was subsequently taken by the railways.	X	
2. The freezing failure of air brake systems was investigated. Special design aftercoolers were developed to alleviate the problem.	X	
3. Air brake cylinder lubrication at low temperature has been a long outstanding problem of the railways. Improved lubricants were developed.	X	
4. In central traffic control regions the automatic operation of track switches is essential. The problem of failure due to ice or snow is under investigation.		X
5. Ingestion of snow in locomotive air intake during winter is under investigation by simulation in the cold chamber.		X
6. Continuous welded rail must be anchored at a suitable temperature if it is not to fail in subsequent service. Experiments are being conducted on means of cooling the continuous welded rail during the laying process.		X

Climatic Equipment

1. Catalytic combustion heaters developed in the laboratory are now in production by Canadian manufacturers, one type for aviation purposes and the other for general camping use.	X	
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	<u>1963</u>	<u>1968</u>
2. The reduction of the velocity of sound with temperature has been exploited in a boiling nitrogen compressor apparatus for investigating the diffuser performance of centrifugal compressors at high tip speeds.	X	

Climatic Testing

1. Engine and vehicle cold starting tests were carried out at low temperature.	X	X
2. The performance of various engineering equipment was investigated at low temperatures.	X	X

Fuels

1. Pyrotechnic ignition of alcohol and liquid oxygen under vacuum conditions.	X	
2. Hypergolic ignition of gaseous oxygen and liquid hydrogen under vacuum conditions.	X	
3. Theoretical studies aimed at producing the best design features for hydrogen-oxygen engines in multi-stage rocket vehicles.	X	X
4. Investigation of heat transfer in a 500 lb. thrust rocket combustion chamber using a water cooled chamber burning hydrogen and oxygen.		X
5. Experiments on cryogenic tankage.		X
6. Experimental investigation of the evaporation of fuel sprays at high temperatures and pressures.	X	X
7. Development of a laboratory procedure for establishing performance standards for power saw spark arrester mufflers.		X
8. Development of a low pressure propane gas heater for railway switch heating.		X
9. Evaluation of drum coating effectiveness and fuel deterioration in the long term storage of hydrocarbon fuels in coated steel drums.	X	X

	<u>1963</u>	<u>1968</u>
10. Evaluation of methods for determining the electrical conductivity of aviation fuels.		X
11. Investigation of electrostatic charging during aircraft refuelling operations.	X	
12. Investigation into the effect of fuel additives on the water separation properties of filter-water separators.	X	X
13. Study of the significance of Water Separation Index, modified in relation to filter-separator performance.		X
14. Study of the mercaptide gel forming tendencies of No. 2 burner fuels.		X
15. Investigation of laboratory methods for predicting low temperature flow properties of diesel and heating fuels and assessment of their suitability.		X
16. Investigation of the stability of highly compressed fuel gases.		X

Lubrication

1. Analysis of friction and wear processes including the seizure of lubricated surfaces and the action of soft metal solid film lubricants.		X
2. Analysis of the mechanism of adhesion between non-conforming metal surfaces.		X
3. Rail curve lubricants and lubricators.	X	
4. Assessment of wear in shotgun barrels with shot manufactured from different materials.		X
5. Laboratory measurement of friction between wire ropes and wheels in the presence of lubricants.		X
6. Laboratory cylinder liner and piston ring wear tests and their correlation with full scale diesel engine results.		X

	<u>1963</u>	<u>1968</u>
7. Co-operative programme for the assessment of instrument oils and surface coatings in the bearings of miniature rotating electrical components.		X
8. Investigation and improvement of laboratory engine test procedures for evaluation of oxidation, dispersancy and thermal stability characteristics of engine oils.	X	X
9. Development of a method for determining solid contaminants in aircraft turbine and piston engine oils.	X	
10. Development of full-scale axle procedures for the determination of the anti-score performance of hypoid gear oils.	X	X
11. Co-operative investigation covering used oil analysis and inspection of engines from Ottawa Transportation Commission buses to establish realistic oil and filter change periods and relationships between oil properties and engine condition.	X	X
12. Studies on the use of vapour space corrosion inhibitors in steam turbine oils	X	X
13. Corrosivity of E. P. steam turbine oils.	X	
14. Development of a specification and suitable evaluation methods for underwater grease.	X	
15. Investigation of low temperature characteristics of multi-purpose gear oils.	X	
16. Examination and evaluation of re-refined oils.		X
17. Investigation of laboratory methods for predicting flow properties of engine and gear oils under low temperature conditions.		X
18. Investigation of laboratory methods for determining properties of multi-grade engine lubricating oils under high shear rate conditions.		X

	<u>1963</u>	<u>1968</u>
19. Studies of chain saw lubricants using the chain saw rig and standard laboratory methods including correlation with field performance and wood cutting trials.		X

Hydraulic Fluids

1. Correlation of a simplified rig for the evaluation of performance characteristics of hydraulic brake fluids with full-scale brake system performance.		X
2. Development of a high viscosity index hydraulic oil specification for naval use.		X
3. Low temperature performance of hydraulic oils in pump systems.		X

Miscellaneous

1. Preparation and cataloguing of infra-red spectra of compounds related to fuels, lubricants and associated products.	X	X
2. The application of atomic absorption spectroscopy to the determination of metals in petroleum products.		X

Manufacturing Techniques

1. Precise digital read-out systems suitable for both the inch and metric systems have been brought into use.		X
2. The moiré fringe technique has been applied to precise angular measurement for the grinding of gear teeth with an accuracy of ± 1 sec. of arc.		X
3. A wide variety of applications of the technique of electrodischarge machining have been made and demonstrated to possible industrial users.		X
4. The technique of electrochemical machining has been brought to a reasonable standard of perfection and is being put at the disposal of Canadian industry.		X

NATIONAL AERONAUTICAL ESTABLISHMENTList of Major Projects - 1963 and 1968Aerodynamics Program

	<u>1963</u>	<u>1968</u>
1. Dynamics of non-rolling ballistic missile.	X	
2. Theory of vortex wake of a lifting fuselage.	X	
3. Theory of vortex bursting.	X	
4. Forces on flat plates in turbulent flow.	X	
5. Stability derivatives for bodies of revolution in supersonic flow.	X	X
6. Study of fluidic amplifiers.	X	X
7. DeHavilland aircraft with flap boundary layer control.	X	
8. DeHavilland Otter aircraft.	X	
9. Theory of inviscid hypersonic flow over wing body combination.	X	
10. Canadair CL-84 VTOL aircraft	X	
11. DeHavilland model with slotted flaps.	X	
12. Bristol Aerojet Black Brant II and IV rockets.	X	
13. Canadair CL-89 surveillance drone.	X	
14. Stability of Bristol Black Brant IV rocket.	X	
15. Effect of viscosity on stability derivatives.	X	
16. Laminar flow separation about slender elliptic cones.	X	
17. Investigation of St. Therese crash of aircraft CF-TJN.	X	
18. Aerodynamics of 3.2 calibre recoilless gun projectile.	X	
19. Supersonic calibration of trisonic tunnel.	X	
20. Quadratic effects of frequency on aerodynamic derivatives.	X	

	<u>1963</u>	<u>1968</u>
21. DeHavilland Hydrofoil model.	X	
22. Performance of modified supersonic diffuser.	X	
23. Research on airspeed sensing - pitot-static tubes.		X
24. Development of low-velocity anemometer.		X
25. Construction of 30-foot V/STOL wind tunnel.		X
26. Aerodynamic stability of bridges.		X
27. Unsteady aero-ablation studies.		X
28. Aerodynamic study of DeHavilland augmentor wing.		X
29. Theory of axisymmetric hypersonic intakes.		X
30. Parametric approximations for boundary layers with suction or injection.		X
31. Propagation of blast waves in hypersonic nozzles.		X
32. Numerical solution for conical bodies in a supersonic stream.		X
33. Canadair CL-41G-5 aircraft stores jettisoning.		X
34. Canadair CL-215 study of water release.		X
35. Angle of attack probe for Black Brant sounding rockets.		X
36. DeHavilland ducted fan.		X
37. D.R.B. CARDE Jezex configurations.		X
38. Influence of body flexibility on stability of sounding rockets.		X
39. Aerodynamics of Bristol Aerospace tactical met. rocket.		X
40. Aerodynamics of Laval University ellipsoid.		X
41. Modular intake studies with McGill University.		X
42. High Reynold's Number Boeing 2-D high lift wing.		X

	<u>1963</u>	<u>1968</u>
43. DeHavilland models WTA, WTBC, WTBA and WTZ.		X
44. Wind tunnel wall effects on V/STOL models.		X
45. V/STOL aircraft propellor-wing interactions.		X
46. Aerodynamics of spinning mortar shell.		X
47. Aerodynamics of D.R.B. "Moby" model.		X
48. Transonic flow characteristics for Lockheed Aircraft.		X
49. Wind characteristics in Locna Lake Valley, B.C.		X
50. Separated flow over long slender bodies of revolution.		X

Flight Mechanics Program

1. Supersonic deployment of crash position indicator.	X	
2. Thrust augmentation of ejectors.	X	
3. Weathercock stability of V/STOL aircraft.	X	
4. Turbulence associated with frontal systems and throughs.	X	
5. Influence of dihedral effect on V/STOL aircraft.	X	
6. Behaviour of liquid droplets in airstreams.	X	
7. Low altitude turbulence over hilly terrain.	X	X
8. Magnetic anomalies over Mid-Labrador Sea Ridge.	X	
9. Investigation of St. Therese crash of aircraft CF-TJN.	X	
10. Dynamic analysis of helicopter haul-down system.	X	
11. Field trials of the Bell Carabao vehicle.	X	
12. Development of high resolution airborne magnetometry.	X	X
13. Cooperative Geomagnetic Micropulsation Measurement Program.	X	
14. Precipitation Physics project (rain-making).	X	

	<u>1963</u>	<u>1968</u>
15. Effect of lateral-directional control cross-coupling on flying qualities.	X	
16. Investigation of slipstream deflection and high lift devices applicable to STOL and VTOL aircraft.	X	
17. STOL performance of an overloaded VTOL aircraft.	X	
18. Helicopter crash position indicator.		X
19. Vertical gradient compensator for magnetometry.		X
20. Development of a flow vane for high speed aircraft.		X
21. Evaluation of infra-red spectrometer as a Clear Air Turbulence detector.		X
22. Investigation of atmospheric turbulence (mountain wave and storm).		X
23. Forest fire control by aerial methods.		X
24. Investigation of flying qualities and control system requirements applicable to V/STOL aircraft.		X
25. Range trials of C5A radio beacon airfoil.		X
26. Investigation of CF-TJM aircraft crash at Ottawa.		X
27. Compensation trials on Royal Dutch Navy Tracker aircraft.		X
28. Trials of N. R. C. radar altimeter in Guatemala.		X
29. Design of new submarine magnetic anomaly simulator.		X
30. Development of airborne infra-red scanner system.		X
31. Stability of Avian gyroplane.		X
32. Utilization of aircraft in agriculture and forestry.		X

Structures and Materials Program

1. Dynamics of high velocity penetration into clay.	X
2. Modes and frequencies of built-up wings.	X

	<u>1963</u>	<u>1968</u>
3. Stress analysis of uniform circular rings.	X	
4. Effect of atmospheric humidity on fatigue of metals.	X	
5. Hydrothermal synthesis of chrysotile asbestos.	X	
6. Response analyses for random structural excitation.	X	
7. Full-scale fatigue test of CF-100 aircraft.	X	
8. Ultra-sonic determination of bulk modulus of fluids.	X	X
9. Aircraft operational flight loading.	X	X
10. Creep-rupture of pressure vessels.	X	
11. Maintenance of Standards and Calibration of instruments.	X	X
12. Theory of transmission tower vibration.	X	
13. Fracture analysis by electron microscopy.	X	X
14. Thermal fatigue of structural alloys.	X	
15. Full-scale strength test of FBA-2C aircraft.	X	
16. Theory of tapered beams on an elastic foundation..	X	
17. Effect of interposed stress reversals on fatigue strength.	X	
18. Investigation of St. Therese crash of aircraft CF-TJN.	X	
19. Impact loading of plate-like grids.	X	
20. Structural verification of prototype ore car.	X	
21. Investigation of turbojet air casing vibration.	X	
22. Non-destructive testing of bonded joints.	X	
23. Flutter investigation of FBA-2C aircraft.	X	
24. Rods of axially varying cross-section in longitudinal vibration.	X	
25. Vibration of slender structural members.	X	

	<u>1963</u>	<u>1968</u>
26. Construction of 1000 ft./sec. bird impact simulator.		X
27. Automobile deicing and demisting.		X
28. Automobile flow control theory.		X
29. Automobile-cable barrier impact dynamics.		X
30. Research on high temperature alloy protective coatings.		X
31. Optimization of properties of composite materials.		X
32. Formulation of a new triangular plate bending element.		X
33. Investigation of an automobile telefactoring simulator.		X
34. Fatigue of maraging steels.		X
35. Study of jet noise suppression.		X
36. Stress intensity factors for a progressing crack.		X
37. Theory of the elastic suspension of a rigid body.		X
38. Vibration of a curved fan blade.		X
39. Applications of extended beam theory to flat plates.		X
40. Transmission matrices for the vibrations of tapered rods.		X
41. Fatigue resistance under a low altitude aircraft load spectrum.		X
42. Fatigue of structural grade steel bolts.		X
43. Response of structures to high intensity noise.		X
44. Non-linear flutter of a circular cylindrical shell.		X
45. Fatigue investigation on the CL-41 aircraft.		X

PRAIRIE REGIONAL LABORATORY - SASKATOON

	<u>1963</u>	<u>1968</u>
<u>Physiology and Biochemistry of Fungi - Section I</u>		
1. Isolation, identification and morphology of new strains and species	X	
2. Rusts and related fungi	X	
3. Antimicrobial activity of detergents	X	
4. Function of cell components in fungi		X
5. Function and action of cell membranes in relation to activity of polyene antibiotics		X
6. Effects of chemical compounds on cell membranes in fungi		X
7. Production of antibiotics by fungi	X	X
8. Production of enzymes by fungi	X	X
9. The chemical structures of metabolic products from fungi other than antibiotics and enzymes	X	X
10. Biosynthesis of aspergillic acids and echinulin in fungi	X	
11. Microbial degradation of falvonoids	X	
12. Biosynthesis of antibiotics		X
13. Enzymic degradation of mannans and glutamic acid		X
<u>Physiology and Biochemistry of Bacteria - Section II</u>		
1. Preparation of pure enzymes from bacteria	X	X
2. Structure of microbial polysaccharides		X
3. Biosynthesis of microbial polysaccharides		X
4. Metabolism of allose and altrose	X	

	<u>1963</u>	<u>1968</u>
5. Bacterial degradation of cinnamic acid	X	
6. Bacterial degradation of cyclohexane compounds		X
7. Bacterial degradation of phenylacetic, phenylpropionic and fluorophenyl acetic acids	X	X
8. Bacterial degradation of hydrazines	X	
9. Symbiotic nitrogen fixation of legumes and microorganisms		X
10. Utilization of <u>D</u> - and <u>L</u> -amino acids by yeasts	X	
11. Antibiotics from myxobacteria	X	
12. Obligate parasitism in microorganisms		X
13. Application of computers to cataloguing of information on microbial culture collections		X
<u>Chemistry of Natural Products - Section III</u>		
1. Analysis of volatile oils and terpenes	X	X
2. Chemotaxonomy based on species differences in composition of essential oils	X	X
3. Chemistry of terpenes	X	X
4. Chemistry of cyclitols	X	
5. Hydrogenolysis of carbohydrates		X
6. Chemical reactions of glycosyl halides	X	
7. Periodate oxidation of carbohydrates	X	
8. The carbohydrates of cereals	X	
9. Polysaccharides as a basis for chemotaxonomy of yeasts		X
10. Analytical methods for lipids	X	X

	<u>1963</u>	<u>1968</u>
11. Chemical reactions of lipids	X	X
12. Composition of oil and waxes from wheat leaf and stem	X	X
13. Metabolism of oxygenated fatty acids in fungi	X	X
14. Effects of rapeseed oil in diets of rats and mice	X	
15. Effects of rapeseed oil in diets of chickens and turkeys		X
16. Effect of composition of dietary oils on the depot fats of mice, rats and chickens	X	X
17. Biosynthesis of fatty acids in rapeseed	X	
18. Biosynthesis of fatty acids in flax and sunflower seed		X
19. Biosynthesis of plant proteins	X	X
20. Structure of plant proteins	X	X
21. Metabolism of wheat rust spores	X	
22. Plant ribosomal proteins		X

Plant Physiology and Biochemistry - Section IV

1. Biosynthesis of thioglucosides	X	X
2. Biosynthesis of coumarins	X	X
3. Biosynthesis of flavonoids	X	X
4. Biosynthesis of lignins and aromatic amino acids	X	
5. The growth and maintenance of plant cell cultures	X	X
6. Metabolism of plant growth regulators		X
7. Production of anthocyanins by potato tubular cells		X
8. Continuous culturing of plant cells		X

	<u>1963</u>	<u>1968</u>
9. Biosynthesis of RNA in plant cells		X
<u>Process Development - Section V</u>		
1. Continuous culture of yeasts, bacteria and fungi	X	X
2. Comparisons of culture methods	X	X
3. Production of polyhydric alcohols by yeasts	X	
4. Glycolipids from yeasts	X	
5. Oxygen transfer and metabolism in yeasts	X	X
6. Polysaccharides from yeasts	X	X
7. Biosynthesis of hydroxy acids by yeasts		X
8. Optimum processing conditions for rapeseed	X	
9. Composition of fats	X	X
10. Determination of thioglucosides in rapeseed and rapeseed meals		X
11. Gas-liquid chromatography of amino acids	X	
12. Fractionation of plant proteins to provide protein concentrate		X
13. Fibre board production from crop residues and native woods	X	
14. Strength and moisture resistance of fibre boards	X	
15. Utilization of jack pine as a pulp source		X
16. Solvent pulping of native woods and straw		X

DIVISION OF PURE CHEMISTRYAnnotated List of Major Projects - 1963 and 1968

Most of the work in this Division consists of relatively long term research in fields considered to be the most productive of scientific information of general value. A very important part of this work involves the development and exploitation of powerful new physical techniques for the investigation of molecular systems. The interchange of such knowledge between university, industrial, and government laboratories is essential to the development and maintenance of an up-to-date scientific capability.

1963 1968

Physical Studies

- | | | |
|--|---|---|
| 1. Studies of organic single crystals and semi-conductors; photoexcitation and photoconduction initiated by intense laser illumination. Development of techniques for injection of holes and electrons in organic crystals to generate emission of light | X | X |
| 2. Development of new nuclear magnetic resonance (NMR) techniques using a high-field superconducting magnet | | X |
| 3. Studies of aromatic radical ions, of crystal-line charge-transfer complexes and of π - electron densities in aromatic molecules and ions by electron spin resonance (ESR) techniques | X | X |
| 4. Evaluation of bond properties from NMR, Raman and infrared spectroscopy | X | X |
| 5. Development of new Raman spectroscopic techniques using high-powered laser sources | | X |

		1963	1968
(1)	6. Effect of molecular structure on Raman and infrared spectra of complex organic molecules	X	X
(2)	7. Development of techniques for the automation of instrumental analytical spectrophotometry		X
	8.* Study of self-diffusion mechanisms in krypton crystals		X
	9.* Thermochemical measurements of solids and liquids at very low temperatures to deduce magnitudes of intermolecular forces	X	X
	10. Study of the nature of imperfections in crystals and their effect on surface properties	X	
	11. Thermochemical properties of liquid mixtures; excess free energies, enthalpies and volumes	X	X
	12. Calculation of surface energies of crystals	X	
	13.* Structure and properties of porous and absorptive surfaces; permeability of micro-porous carbon to gas flow	X	X
	14.* Accurate measurement of the rates of solvolytic reactions; elucidation of relationship between rates and structural and thermodynamic properties	X	X
	15. Elucidation of mechanisms of photochemical and radiolytic reactions in the gas phase and of the primary photochemical process	X	X
	16. Study of liquid phase photochemical processes; detection of triplet states by flash spectroscopy		X
	17. Reactivity and energetics of gaseous free radicals and ions	X	X
	18. Excitation and ionization process by energy transfer from excited atoms and electrons		X
(1)	This is part of a continuing ICSU and IUPAC standards program for the evaluation of infrared and Raman spectroscopic data. Specifications have been developed for application of automated data storage and retrieval systems.		
(2)	A set of 22 computer programs has been distributed and widely accepted in the chemical industry.		
*	Projects so indicated will terminate in 1969.		

	<u>1963</u>	<u>1968</u>
<u>Organic Studies</u>		
1.* Study of methods for the identification and total synthesis of natural products: alkaloids, steriods, porphyrins	X	X
2.* Determination of structure of organic molecules of biological importance by X-ray analysis	X	X
3.* Development of new methods in organic syntheses. Identification of reaction intermediates: nitrenes, chloramines, carbonium ions		X
4.* Study of possible biosynthetic pathways in higher plants		X
5.* Structure and transformations of pharmacologically important plant products and antibiotics	(3)	X
6.* Study of biopolymers by physical methods (NMR, ESR)		X
7.* Kinetics and mechanism of enzyme action		X
8. Synthesis of a defined sequence of the DNA molecule; new approaches to the synthesis of proteins		X
9. Extraction and chemical identification of natural oils and fatty acids occurring in seeds	X	
10. Physical and chemical properties of natural and synthetic fibers: wool, nylon	X	
11. Development of methods of synthesis of compounds containing radioactive isotopes for tracer studies	(4) X	X

-
- * Projects so indicated were transferred to the new Biochemistry and Molecular Biology Laboratory in late 1968.
- (3) The first determination of the molecular structure and chemical properties of the antibiotic MYXIN was carried out in this laboratory.
- (4) Methods for labelling molecules developed in this laboratory now are used internationally by industry and research institutes.

19631968Theoretical Studies

- | | | |
|----|---|---|
| 1. | Theoretical methods for calculating rate constants for radiationless transitions. Good agreement with experimental data for aromatic molecules has been achieved. | X |
| 2. | General theory concerning the interaction between polaritons and phonons in optical absorption regions by molecular crystals. Calculation of dielectric permeability. | X |
| 3. | Development and application of improved approximation techniques in quantum mechanics using generalized methods of moment. | X |
| 4. | Development of methods of calculation of atomic energy levels from matrix and geminal wave functions; problems in quantum chemistry. | X |

DIVISION OF PURE PHYSICS

The Division of Pure Physics was divided into five sections corresponding to five areas of physics in which work is being carried out. These are:

- (1) Cosmic Rays and High Energy Particle Physics
- (2) Low Temperature and Solid State Physics
- (3) Spectroscopy
- (4) Theoretical Physics (discontinued)
- (5) X-ray Diffraction
- (6) Laser and Plasma Physics (active only in 1968).

The projects listed below are numbered according to the section in which the work was carried out.

		<u>1963</u>	<u>1968</u>
1	The detectors in the Alouette satellite operated very successfully to give information on the type and the energy of particles in the Van Allen belt and the variation in the position of this belt with time.	X	
1	Analysis of a large volume of data on particles in the magnetosphere is being continued and new experiments are being designed for the ISIS satellites which will be launched in 1969 and 1970.		X
1	A fourth cosmic ray station was established to supplement the three already in operation in Canada. The data from these stations is used to study the time variation of certain components of cosmic rays.	X	
1	Cosmic ray monitors have been maintained and improved at the various stations and an analysis of the change in the intensity of the nucleon component of cosmic rays throughout the solar cycle is being analysed.		X

		<u>1963</u>	<u>1968</u>
1	Some initial experiments on μ -mesonic X-rays were carried out and apparatus was constructed to obtain higher precision. These experiments were carried out in cooperation with a group from the University of Chicago using the Chicago accelerator.	X	
1	Extensive data on μ -mesonic X-rays from seventeen elements is being analysed.		X
1	Experiments aimed at determining the energy and the direction of motion of particles present in the aurora were being designed. These experiments were carried out by means of rockets fired at Churchill.	X	
1	An experiment on high energy proton-proton reaction is being concluded.		X
2	Studies were made of the heat and electrical conductivity of rubidium and caesium at low temperatures.	X	
2	Studies of the magnetic susceptibilities of metals at low temperature were carried out.	X	
2	The specific heats of both isotopes of lithium and of sodium were measured from 0.4°K to 300°K.	X	
2	The specific heat of silver-gold alloys is being investigated at temperatures below 3°K, and the influence of nuclear specific heat has been measured.		X
2	A study of the structure and the distribution of defects in extremely pure copper was undertaken in order to have a better understanding of its mechanical properties.	X	
2	Theoretical studies of transition metal compounds were carried out.	X	
2	A large computer program has been written which permits the calculation of Fermi surfaces of materials involving rare earth elements.		X

		<u>1963</u>	<u>1968</u>
2	The collection and publishing of data on the structures of materials is continuing. These data are published under the auspices of the International Union of Crystallography.		X
2	A computer has been fitted with software and programmed to allow a rapid collection and reduction of data on defects in metals.		X
2	An apparatus has been constructed which allows a very precise measurement of the DeHaas-van Alphen effect and its variation with pressure. With this dilute alloys have been studied and the nature of the Fermi surfaces determined.		X
3	Microwave measurements of the spectra of a number of molecules which show internal rotations were carried out and the barrier to rotation determined.	X	
3	The spectra of NH_3 , ND_3 , NO and BH were investigated with the high resolution vacuum spectrograph.	X	
3	Spectra of the free radicals CH , CH_2 , HSiCl , C_3 , HSiBr , SiH_2 and HCO were studied by the flash photolysis technique.	X	
3	A new large spectrograph was completed. This instrument is used in the study of large molecules.	X	
3	The interaction of a light pulse from a Q switched ruby laser with liquids was investigated. The very high intensity pulses produced a number of unusual results which have since been studied in great detail in many laboratories.	X	
3	Spectroscopic methods have been devised to study in detail the collision processes in atoms and molecules.		X
3	Electronic spectra of BF , HNF , H_2 , AlH , HCP and Mg_2 were investigated.		X

		<u>1963</u>	<u>1968</u>
3	Spectroscopic molecular constants for all known diatomic molecules are being collected and assessed prior to publication.		X
3	A detailed analysis of the glyoxal spectrum is being carried out using a complex computer program which has been written and tested over the past two years.		X
3	The nuclear magnetic moment of praseodymium has been measured.		X
4	Theoretical studies of nuclear scattering processes were carried out.	X	
4	Advances were made in the theoretical understanding of plasmas. These results were subsequently combined with a general survey and published as a book.	X	
5	Computer programs were written which assist in the determination of crystal structure by means of X-ray diffraction. These programs are now used in many laboratories throughout the world.	X	
5	A method has been developed for checking computer programs used in crystallography.		X
5	The structures of some complex minerals and a number of organic crystals were determined. The X-ray crystallography section has now been transferred to the new Biochemistry and Molecular Biology Laboratory.	X	X
6	The study of the scattering of light by a plasma is being continued in order to obtain detailed information on the energy distribution and the cooperative motions of the charged particles.		X
6	The construction of a high intensity short pulse laser is in progress and work has already been carried out with pulses with a duration of less than 10^{-10} sec.		X

6

Intense light pulses generated by a laser can cause sparks in gases. The nature of these sparks is being investigated by a number of methods.

19631968

X

RADIO & ELECTRICAL ENGINEERING DIVISIONList of Major Projects - 1963 and 1968

<u>RADIO ASTRONOMY</u>	<u>1963</u>	<u>1968</u>
1. Continuing observations of solar emissions.	X	X
2. Construction of new instruments at the Algonquin Radio Observatory.	X	
3. Field expedition to carry out microwave observations of solar eclipse.	X	
4. Measurement of diameters of quasars, using long baseline interferometer. (With EM & R; Queen's, U. of T.).		X
5. Microwave spectra of sources in the 3CR (Cambridge) catalogue.		X
6. Microwave observations of planetary nebulae.		X
7. Observations of variable sources.		X
8. Polarization measurements.		X
9. Solar and galactic observations with compound interferometer.		X
<u>ELECTRON PHYSICS</u>		
1. Development of monopole mass spectrometer.	X	
2. Construction of apparatus for thermomolecular measurements.	X	
3. Calculation of physical adsorption isotherms.	X	
4. Low energy electron diffraction studies.	X	
5. Effects of ionic entrapment and gas chemisorption on tungsten.		X
6. Trapped-ion spectrometry.		X
7. Development of apparatus for studying molecular diffraction.		X

	<u>1963</u>	<u>1968</u>
8. Continuing refinements to instrumentation for (1) the production and measurement of ultrahigh vacuum.	X	X

SOLID STATE

1. Studies of fluorescence in alkali halides.	X	X
2. Optical absorption spectra of potassium bromide crystals.	X	
3. Photoconductivity of polyethylene.	X	
4. Studies of ionic conductivity.		X
5. Electro-optical effects in molecular crystals.	X	X
6. Fluorescence spectra of anthracene.		X

UPPER ATMOSPHERE RESEARCH

1. Continuing observations, -visual, photographic and radar, -of meteors and auroral phenomena.	X	X
2. Airglow studies during the solar eclipse.	X	
3. Preparation for International Quiet Sun Year (1964-65).	X	
4. Polar cap absorption studies, carried out at Churchill Research Range.		X
5. Conjugate point auroral observations - Great Whale River, P. Q. and Byrd Station, Antarctica.		X
6. Development of automatic equipment for auroral photometry.		X
7. Infra-red airflow research.	X	X

NAVIGATIONAL AIDS

1. Fog horn control - Pelee Passage.	X
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(1) A variety of instruments in this field are licensed for manufacture through Canadian Patents and Development Limited.

	<u>1963</u>	<u>1968</u>
2. Wind speed and direction telemetry - National Parks branch.	X	X
3. Development of transistorized marine radar. (2)	X	
4. Development of bathothermometer for oceanographic research.	X	
5. Digital read-out echo sounder.	X	
6. Testing of microwave position-fixing system.	X	
7. Split-beam microwave beacon - for position fixing.		X
8. Canal radar - for navigation in confined quarters.		X
9. Tone-burst ranging system - to control course of slave vessels in hydrographic survey work. (3)		X

MEDICAL ELECTRONICS

1. Development of operating theatre monitor.	X	
2. Control system for coronary arteriography.	X	
3. Development of area display electrocardiograph.	X	
4. Telemetry of biological data.	X	
5. Application of ultrasonics to echo-encephalography - joint project with Queen's University.		X
6. Studies of biological energy sources.		X
7. Aids to the handicapped - continuing development of equipment to assist in the rehabilitation of the blind.	X	X

(2) Licensed for manufacture by Canadian Marconi Co.

(3) Currently undergoing further trials at Bedford Institute.

1963 1968

MEASUREMENTS & STANDARDS

1. Development of microwave calorimeter.	X	
2. Precision current comparator & potentiometer. (4)	X	X
3. Microwave attenuation standard.	X	
4. Technique for calibrating voltage transformer.	X	
5. Establishment of coaxial impedance standard.		X
6. Provision of routine calibration services to industry.	X	X

MILITARY ELECTRONICS

1. Counter-mortar radar.	X	
2. Sound Ranging system.	X	
3. Anti-jamming equipment.	X	
4. Ship-board antenna development.	X	X
5. Antenna development for CHSS-2 helicopter.	X	

COMPUTER TECHNIQUES

1. Studies in information retrieval.		X
2. Graphic data input to computers.		X
3. Studies in computer aided teaching - in cooperation with U. of T. and University of Calgary.		X
4. Computer controlled displays.		X
5. Computer analysis and synthesis of sound.		X
6. Digital data processing.	X	X
7. Computer interfaces.	X	X

(4) Licensed for manufacture by Guildline Instruments Ltd.

1963 1968

HIGH VOLTAGE

- | | | |
|--|---|---|
| 1. Studies of radio interference from DC Corona. | X | X |
| 2. Corona loss measurements. | X | |
| 3. High voltage testing of transmission hardware for industry. | X | X |
| 4. Dielectric breakdown. | X | X |
| 5. Refinements in HV impulse measurements - cooperative work through International Electro-Technical Commission. | X | X |
| 6. Evaluation of conductor configurations. (5) | | X |
| 7. Study of safe clearances under HVDC lines. | | X |

ROCKET PAYLOAD ENGINEERING (6)

- | | | |
|---|---|--|
| 1. Nose-cone instrumentation and payload development. | X | |
| 2. Telemetry antenna development. | X | |
| 3. Development of data processing equipment. | X | |
| 4. Telemetry transmitter development. | X | |

MISCELLANEOUS

- | | | |
|--|---|---|
| 1. Digital clocks for time service - CHU | X | |
| 2. Terminal equipment for reception of weather satellite signals. | X | X |
| 3. Measurement of conductivity of water in Lakes Erie and Ontario. | X | |
| 4. Provision of engineering services in connection with Alberta Hail Research Project. | X | X |

(5) Included in earlier work was an evaluation of the Nelson River HVDC line for AECL.

(6) This work subsequently taken over by Bristol Aero Industries and University of Saskatchewan.

	<u>1963</u>	<u>1968</u>
5. Development of 2-cm radar for precipitation studies.		X
6. Continuation of work on microwave heating - application to food processing (with Department of Agriculture); ore processing (with University of Waterloo) and miscellaneous manufacturing processes.	(7)	X
7. Development of radar altimeter for use in forest inventory studies.	(8)	X
8. Completion of integrated circuit data encoder for use on Isis A satellite.		X
9. Ad hoc development and testing of antennas for government and industry, using specialized facilities of the antenna laboratory.	X	X

(7) Several developments in this area now licensed for manufacture.

(8) Under license to Leigh Instruments.

VII

INDUSTRIAL RESEARCH ASSISTANCE PROGRAM

The program is intended to stimulate the interest of Canadian industry in research and development and promote the establishment of new industrial research facilities and the expansion of existing industrial research across Canada.

Rights arising out of the research projects are the property of the company. Certain information submitted to the NRC Committee on Industrial Research Assistance and all reports are treated as confidential to protect the interests of the participating companies.

In addition to the material supplied in our report of 23 October to the Committee, attached are tables showing participating companies, the number of projects and the total dollar value of support for the fiscal years 1963 - 64 and 1968 - 69.

Comments are included for some projects which have been publicly released by individual companies.

NATIONAL RESEARCH COUNCIL OF CANADA

INDUSTRIAL RESEARCH ASSISTANCE PROGRAM FY 1963-64

Abbott Laboratories Limited	2 projects	\$ 70,600
Abitibi Power & Paper Company Limited	1 project	14,000
Anglo Paper Products Limited	1 project	15,400
Automatic Electric (Canada) Limited	1 project	71,800
Ayerst, McKenna & Harrison Limited	1 project	72,000
Bathurst Power & Paper Company	1 project	16,600
Brewing & Malting Barley Research Institute	1 project	13,600
Canada Carbon & Ribbon Company	1 project	13,200
Canada Cement Company Limited	1 project	21,400
Canada Freeze-Dry Foods Limited	1 project	20,600
Canada Packers Limited	3 projects	49,800
Canadian Aviation Electronics Limited	1 project	69,500
Canadian Chemical Company Limited (Chemcell)	2 projects	41,800
Canadian General Electric	5 projects	87,200
Canadian Refractories Limited	1 project	49,500
Canadian Technical Tape	1 project	22,000
Cominco Limited	1 project	5,500
Co-Polymer Research & Development Limited	1 project	26,600
Crown Zellerbach Building Materials	2 projects	45,700
DeHavilland Aircraft of Canada Limited	1 project	31,400
Delmar Chemicals Limited	1 project	18,700
Dominion Briquettes & Chemicals Limited	1 project	13,100

Dominion Engineering Works	3 projects	\$ 63,100
Dominion Rubber Company Limited (Uniroyal)	2 projects	140,000
Dominion Tar & Chemical Company Limited	3 projects	55,900
Dow Chemical of Canada Limited	1 project	30,200
Duplate Canada Limited	3 projects	32,100
Ferranti-Packard Electric Limited	2 projects	64,500
Frank W. Horner Limited	2 projects	37,800
General Foods Limited	1 project	14,200
Geo-Met Reactors Limited	1 project	15,500
Glidden Company Limited, The	1 project	36,500
Griffith Laboratories Limited	1 project	11,200
Hunting Survey Corporation Ltd.	1 project	18,200
Imperial Oil Limited	2 projects	46,600
International Cellulose Research	2 projects	28,400
Industrial Minerals	1 project	6,300
John Inglis Company Limited	4 projects	71,900
John Labatt Limited	2 projects	86,500
Johnson & Johnson Limited	1 project	20,100
Lignosol Chemicals Limited	1 project	4,000
Maple Leaf Mills Limited	1 project	16,200
Merck Sharp & Dohme of Canada Limited	1 project	26,600
Northern Electric Company Limited	1 project	40,100
Nuclear Enterprises Limited	1 project	14,500
Ogilvie Flour Mills Company Ltd.	1 project	22,300

Penick Canada Limited	1 project	\$ 12,500
Pioneer Electric Limited	1 project	10,300
Plastiglo Industries Limited	1 project	16,800
Plywood Manufacturers of B. C.	1 project	17,500
Quebec Iron & Titanium Corporation	1 project	37,100
Rio Tinto Dow Limited	2 projects	60,700
Shawinigan Chemicals Limited	2 projects	138,200
Sherritt Gordon Mines Limited	1 project	43,500
South Channel Company	1 project	8,700
Turbo Engineering Company Limited	1 project	14,400
Union Carbide Canada Limited	1 project	38,200
Valeriot Electronics (Guelph) Limited	1 project	2,500
58 Companies	84 projects	\$2,093,100

NATIONAL RESEARCH COUNCIL OF CANADAINDUSTRIAL RESEARCH ASSISTANCE PROGRAM FY 1968-69

Abbott Laboratories Limited	3 projects	\$ 95,300
Abitibi Paper Company Limited	2 projects	50,800
Abrex Specialty Coatings	1 project	81,000
Aerofall Mills Limited	1 project	58,100
Alberta Dairymen's Association	1 project	34,000
Anglo Paper Products Limited	1 project	27,300
ADM Chemicals	2 projects	46,700
Aviation Electric	1 project	60,000
Ayerst Laboratories Limited	3 projects	276,300
Barringer Research Limited	2 projects	91,000
Bobtex Corporation Limited	1 project	75,000
Canada Cement Company Limited	2 projects	57,500
Canada Glazed Papers	1 project	91,300
Canada Packers Limited	5 projects	152,900
Canadian Cannery	1 project	37,700
Canadian Forest Products	2 projects	35,700
Canadian Gas Association	2 projects	42,800
Canadian General Electric	5 projects	131,900
Canadian Industries Limited	4 projects	231,500
Canadian Refractories Limited	1 project	26,000
Canadian Technical Tape	2 projects	81,000
Canadian Westinghouse	4 projects	278,400

Central Electric Wire Limited	1 project	\$ 20,000
Chemcell (1963) Limited	3 projects	124,000
Columbia Cellulose	2 projects	65,800
Combustion Engineering Superheater Limited	1 project	21,500
Cominco Limited	1 project	41,700
Consolidated-Bathurst Limited	2 projects	67,700
Consumers Glass Company Limited	1 project	7,900
Cooperative Agricole De Granby	1 project	27,100
Crane Canada	1 project	47,000
Crown Zellerbach Building Materials	2 projects	84,800
Delmar Chemicals Limited	1 project	87,300
Denver Laboratories (Canada) Limited	1 project	45,700
Desitron Company	1 project	24,000
Dominion Bridge	1 project	50,900
Dominion Engineering Works	4 projects	143,000
Domtar Limited	2 projects	28,400
Dunlop Canada Limited	1 project	72,700
Duplate Canada Limited	1 project	28,900
Eastern Steel Products Limited	1 project	3,000
Electric Reduction Company of Canada	2 projects	38,600
Electronic Instruments Limited	1 project	19,600
Ferranti-Packard Electric Limited	1 project	121,000
Fiberglas Canada Limited	1 project	154,000
Fluid Power Limited	1 project	42,100

Francon (1966) Limited	1 project	\$ 33,700
General Foods Limited	1 project	18,800
Geophysical Engineering & Surveys Limited	1 project	8,300
Glidden Company Limited, The	2 projects	94,900
Horner, Frank W. Limited	3 projects	93,300
Imperial Oil Enterprises	2 projects	98,600
Institute of Microbiology and Hygiene of Montreal University	2 projects	85,800
International Cellulose Research	1 project	26,800
John Labatt Limited	4 projects	109,800
Leco Industries	1 project	56,000
Lignosol Chemicals Limited	1 project	24,000
MacMillan Bloedel Research Limited	8 projects	343,200
Maple Leaf Mills Limited	3 projects	69,700
M & T Products of Canada	1 project	44,500
Merck Sharp & Dohme of Canada Limited	2 projects	81,400
Milltronics Limited	1 project	47,500
Mowatt & Moore Limited	1 project	56,500
New Surpass Petrochemicals Limited	1 project	22,400
Nicholson Building Components	1 project	47,000
Northern Electric Company Limited	3 projects	58,800
Northwest Industries	1 project	33,300
Norton Research Corporation (Canada) Ltd.	3 projects	96,100
Ogilvie Flour Mills Company Limited	1 project	67,200
Picker X-Ray Manufacturing	1 project	25,200

Pioneer Electric Limited	5 projects	\$108,300
Plywood Manufacturers of B.C.	1 project	72,000
Polychemical Industries	1 project	20,400
Pulp & Paper Research Institute	5 projects	140,800
Quebec Iron & Titanium Corporation	2 projects	231,200
Raylo Chemicals	1 project	40,600
Reichhold Chemicals	5 projects	182,400
Reliance Universal of Canada Limited	1 project	4,700
Richelieu Chemical Company	1 project	29,800
Rio Algom Mines	1 project	70,000
S & L Seasonings Limited	1 project	34,200
Scrintrex Limited	1 project	37,500
Shawinigan Chemicals Limited	2 projects	44,500
Silverwood Dairies Limited	1 project	16,000
Slax Incorporated	1 project	7,400
Spilsbury & Tindall	1 project	30,900
St. Lawrence Starch Company	1 project	54,900
Sun-Rype Products Limited	1 project	18,700
Thomson Research Associates	1 project	22,900
Top-Notch Feeds Limited	1 project	7,900
Toronto Copper-smithing Company Limited	1 project	48,800
Trench Electric Limited	1 project	25,900
Union Carbide Canada Limited	5 projects	213,700
Uniroyal	4 projects	503,200

Warner Lambert Research Institute	1 project	\$ 56,400
Wix Corporation Limited	1 project	47,500
Worthington Canada Limited	3 projects	69,800
97 Companies	177 projects	\$7,212,100

INDUSTRIAL RESEARCH ASSISTANCE PROGRAMCanadian Technical Tape Limited
Montreal, Quebec

As a result of work supported under IRAP this company has developed Canadian sources for certain raw materials with an estimated saving in foreign exchange of \$1,000,000 annually.

Raylo Chemicals Limited
Edmonton, Alberta

This company was formed in 1966 in the expectation of obtaining NRC support to manufacture and sell fine organic chemicals. Its first catalogue, recently published, lists 160 chemicals of which 30 to 40 have been developed by the research team supported under IRAP. The company is providing a much needed valuable service to industrial and university research laboratories in Canada.

Delmar Chemicals Limited (Subsidiary of John Labatt Limited)
LaSalle, Quebec

The IRAP supported research team has synthesized and tested many hundreds of new compounds of potential pharmaceutical interest. The chemical work has been reported in four recent publications in the Canadian Journal of Chemistry. A new drug has been submitted to Food and Drug Directorate for approval.

John Labatt Limited
London, Ontario

The IRAP supported project has led to the development of an encapsulation method for the protection of nutrient feed additives while passing through the animal rumen. It is envisaged that this encapsulation

procedure will also be applicable to veterinary products and will have a significant beneficial effect on the economics of beef production.

Research staff of this company has nearly doubled between 1962 and 1968 with approximately 75% of the increase due to support under IRAP. A new \$650,000 "Scientific Centre" is being constructed in London to house the research staff. Further grants have been approved under IRAP.

M & T Products of Canada Limited
Hamilton, Ontario

At the time of first making application for support under IRAP in July 1964, the company had no research staff and inadequate laboratory facilities. As a result of the stimulation of interest in research activity provided by support under the program, the company decided not only to build a new research laboratory, but also a 17,000 sq. ft. plant addition at a total cost of \$500,000. In addition to support for the research staff of two professionals and three technicians, IRAP also provided for support of chemical Engineering Consultants Limited (University of Toronto) to assist with the initiation and direction of the project.

The project work is concerned with a study of the basic chemistry of organic and inorganic tin compounds and has already made substantial contributions to the economics of processes currently operated at the Hamilton plant.

MacMillan Bloedel Limited
Vancouver, British Columbia

The company first received support under IRAP for four projects. Support was provided for 21 research workers and the total company

Special Committee

research staff was increased at that time from 77 to 104. In 1968, the company embarked on another major expansion effort and the staff was increased to 128 of which 30 receive IRAP support on eight projects. Projects are in the major areas of company long term interest, including improved pulp processes, continuous production of plywood, and utilization and economic upgrading of existing forest product wastes. A major success is reported on a high yield pulp process, now proceeding to pilot plant development, which will be of major economic significance.

Quebec Iron and Titanium Corporation
Sorel, Quebec

As a result of support under IRAP the research staff of this company has increased from 11 in 1963 to 53 in 1968, of which 23 are supported under the program. The company has recently completed construction of a modern research center at a cost of \$1.5 million.

The company is a major supplier of titanium bearing material to the pigment industry and was faced with serious competition from suppliers of material produced by the chloride process. The support has enabled the company to build up a very capable team in the field of titanium technology to maintain a competitive position. New processes have been evolved for which the economics will have to be determined.

Lignosol Chemicals Limited
Quebec City, Quebec

Support was granted to develop a process for the utilization of spent sulphite liquor which is largely a waste product. As a result, a new

process for the production of a dye dispersant was developed.

The company has recently reported sales growth in the U. S. and other export markets.

Other products are under development and the company has recently completed a major plant expansion.

Uniroyal Research Laboratories
Guelph, Ontario

Assistance provided under IRAP has been responsible for a five fold increase in staff since 1962. The company has now purchased 300 acres in Burlington, Ontario, with the intention of building an extensive new research centre.

The supported research has been directed towards the discovery of new chemicals for use in the rubber and plastics industries and in agriculture, and also towards an understanding of the physical and chemical properties of polymers in relation to their chemical constitution.

An outstanding result of the work has been the discovery of a group of systemic organic fungicides of great potential importance to Agriculture for the control of smuts and rust. Experimental quantities measured in tons have been used successfully in many countries throughout the world. It is anticipated that commercial quantities will be sold in Europe this year, and in North America as soon as clearance with the Food and Drug Administration has been obtained.

The polymer work has contributed to major improvements in conveyor belts and crash pads and shows promise in the field of vulcanisation, flameproofing and sealants.

The company has recently been granted support for work on the extraction of commercially useful products from seaweed, and on pollution.

Harco Electronics Limited
Winnipeg, Manitoba

As a result of IRAP grants totalling \$97,000 this very small company, starting in 1962 in a small, single room laboratory, initiated research intended to produce medical electronic monitoring instruments. These were to be of a portable type to replace or be used in addition to the very large, expensive machines restricted to fixed locations in hospitals. With the enthusiastic cooperation of a group of Winnipeg doctors, who had stressed the need for such instruments, the project has resulted in the commercial production of some fifteen different types and models for monitoring blood pressure and pulse rate, fetal heart beat and similar applications. In 1968 the company moved into a modern, new building containing enlarged research and manufacturing facilities to produce these instruments, over 600 of which are in use all over the world, since the company is aiming particularly at the export market.

Northern Electric Company Limited
Ottawa, Ontario

As a result of three projects supported by IRAP grants, this company has:

- (a) Obtained extensive fundamental knowledge concerning ferromagnetic materials, which is now being used to

develop new high quality ceramic ferrite materials for varied industrial uses.

- (b) Undertaken fundamental and applied research in the field of electrets which already has resulted in the development of an experimental, lightweight, long life, low current telephone microphone, which is probably the first significant improvement in telephone transducer devices since the carbon microphone was introduced nearly a century ago. It will have applications in the public address and broadcast equipment field as well as in the telephone industry.
- (c) Developed a hydraulically-operated artificial arm and hand controlled by electrical or mechanical devices mounted on the patient's body. This is a unique system and places Canada in a leading position in this field, in which the Russians are also engaged. The prototypes were turned over to the Rehabilitation Institute of Montreal in 1968 and will be used particularly with children and young adults. Further refinements will be made as experience is gained with the prototypes in actual use.

Three research teams, expert in their field, and special laboratories have been established in the company as a result of these projects.

Automatic Electric (Canada) Limited
Brockville, Ontario

Support was provided for an increase of research staff to undertake the design, construction and testing of an experimental electronic common control telephone switching system for small exchanges. The project was entirely successful and the concepts used in the experimental system were developed by the company in the design of a 2400 line, class 5 Central Office Switching System which is now in commercial production in their Canadian plant.

As a result of IRAP support, a development laboratory has been established in the Canadian company which, the company advises, probably would not have been built for years, if ever.

Sun-Rype Products Limited
Kelowna, British Columbia

This company is the manufacturing unit of B.C. Tree Fruits Limited, a cooperative organization representing 3300 growers. It started its own research facilities in 1967 with an IRAP grant to develop a use for pomace, the residue after juice is extracted from apples, which is the major product in the fresh fruit field. Pomace is now sold for stock feed but more profitable uses are being sought.

The company has continued its close association of many years with the Department of Agriculture's Research Station at Summerland, B.C., which is providing the IRAP liaison and scientific assistance to the project. The company reports a large number of products in 1968 of which fifteen have market possibilities, the remainder require further testing.

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird
Belisle
Bourget
Cameron
Desruisseaux
Grosart

Hays
Kinnear
Lamontagne
Lang
Leonard
MacKenzie

O'Leary (*Carleton*)
Phillips (*Prince*)
Robichaud
Sullivan
Thompson
Yuzyk

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

THURSDAY, January 30, 1969

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Aird, Grosart, Hays, Kinnear, Robichaud, Sullivan and Thompson—8.

Present but not of the Committee: The Honourable Senators Haig and Molson—2.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

THE SCIENCE SECRETARIAT

Dr. J. R. Weir, Director;

Dr. J. R. Whitehead, Principal Science Adviser;

Dr. André Desmarais, Principal Science Adviser; and

Dr. E. O. Hughes, Scientific Adviser.

(A curriculum vitae of each witness follows these Minutes.)

The following is printed as Appendix No. 23.

Brief submitted by the Science Secretariat of the Privy Council.

At 12.45 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Weir, John Robert, B.S.A., M.Sc., Ph.D., D.Sc., F.A.I.C., F.A.A.A.S., F.R.S.A. Dr.

Weir was born in Wingham, Ontario, on October 17, 1912. He attended Wingham High School and Stratford Normal School prior to beginning his studies in agriculture. Following graduation from the University of Toronto in Agriculture Dr. Weir attended the University of Alberta where he obtained his M.Sc. (1938) and the University of Minnesota where he obtained his Ph.D. (1944). He held research assistantships at both these universities. His graduate studies were in plant genetics and plant physiology. He joined the Department of Field Husbandry at the Ontario Agricultural College in 1940 and remained with the Department for 12 years, advancing from Lecturer to Professor. In 1952 he accepted the position of Dean of the Faculty of Agriculture and Home Economics at the University of Manitoba, leaving there in July 1965 to become Deputy Director of the Science Secretariat. He became Director of the Science Secretariat in July 1967. In May 1966 Dr. Weir was awarded the honorary degree of Doctor of Science by the University of Manitoba. Dr. Weir is a Fellow of the Agricultural Institute of Canada, and in 1962 was the National President of that Institute. He is also a Fellow of the American Association for the Advancement of Science and of the Royal Society of Arts. He was a member of several Senate Committees of the University of Manitoba as well as various federal and provincial agricultural advisory committees and has served on the Committee of Deans of Agriculture and Veterinary Medicine. In 1959 he was an official Canadian delegate at the Conference of Higher Education in Agriculture held in Paris and sponsored by the Organization for European Economic Co-operation and has attended numerous other international scientific meetings. He was Chairman of the 1961 Steering Committee of the National Conference on Farm Policy Research and Chairman of the Research Directorate, Agricultural Economics Research Council of Canada. He is a former director of the Manitoba Cancer Relief and Research Institute, 1953-57, and was a member of the Manitoba Research Council, 1963-65, as well as the American Genetic Association and the Canadian Corporation for the 1967 World Exhibition. In 1961 he was invited to serve on the Royal Commission on Government Organization (Glassco Commission) and spent almost the whole of that year on a study of the scientific and industrial research activities of the Canadian Government. In 1964 Dr. Weir served as a consultant to the Ford Foundation on university organization in Brazil, and in 1966 he was appointed Chairman of a Commission for Agricultural Education in Kenya by the Rockefeller Foundation. He was a guest speaker at a plenary session of the Fourth Commonwealth Education Conference in Lagos, Nigeria in February 1968. In the past few years he has visited research and educational institutions in Western Europe, the British Isles, Australia, New Zealand, Brazil, South America, the West Indies and Eastern and Western Africa.

Whitehead, James Rennie, B.Sc. (Manc.), Ph.D. (Cantab.). Dr. J. Rennie White-

head was born in Lancashire, England, on August 4, 1917. Following graduation in Physics from Manchester University in 1939, he entered the Telecommunications Research Establishment (now the Royal Radar Establishment at Malvern,

Worcestershire). He designed the Mark III I.F.F. air-borne and ship-borne transponder and later headed the radar identification group. He was also secretary to a sub-committee of the War Cabinet Operations and Technical Committee. In 1944, he was a member of a War Cabinet Mission to the Combined Chiefs of Staff in Washington, and he spent a year on scientific liaison in Washington, D.C. On his return to the United Kingdom in November, 1945, Dr. Whitehead became head of a research group on pulsed light and millimetre waves which, in 1946, made the first experimental operating radar on a wavelength below one centimetre. The same year, he went on loan to the University of Cambridge as a consultant in electronics to a group on the Physics and Chemistry of Solids. At Cambridge, in 1949, he obtained his doctorate degree in the Department of Physical Chemistry, and wrote the book, "Superregenerative Receivers", on the principles behind his war-time radar work. Dr. Whitehead emigrated to Canada in 1951 and joined the Eaton Electronics Research Laboratory of McGill University. While Associate Professor of Physics at McGill during the years 1951-55, he was responsible, on behalf of the Defence Research Board, for the major research and development associated with the "McGill Fence" (Mid-Canada Line). In 1955, Dr. Whitehead joined the RCA Victor Company, Ltd., Montreal, as Director of Research, with responsibility for initiating and developing research laboratories which are now extensive. In 1961, he was invited to serve on the Royal Commission on Government Organization and spent the greater part of that year on a study of the scientific and industrial research activities of the Canadian Government. On May 31, 1965, Dr. Whitehead was appointed a Deputy Director of the Science Secretariat, Privy Council Office. On July 1, 1967 he was appointed Principal Science Adviser. Dr. Whitehead is a Fellow of the Institute of Physics and of the Institution of Electrical Engineers, and an Associate Fellow of the Canadian Aeronautics and Space Institute. He is a Senior Member of the Institute of Electrical and Electronic Engineers, and a Member of the Canadian Association of Physicists, the American Physical Society and Sigma XI. He is a Professional Engineer of the Province of Ontario, and has been for several years on the Board of the Canadian Research Management Association.

Desmarais, André (B.A., L.Sc., Ph.D., F.R.S.C.). Born in Pierreville, Que. in 1919. Secondary Education at Le Séminaire de Nicolet (1931-35) and College education at Collège de St-Laurent (1936-40), obtaining B.A. from Université de Montréal in 1940, and L.Sc. (biology) from same university in 1943, and Ph.D. in 1948 from Université Laval. He has received a travelling fellowship from NRC (summer 1945), a Province of Quebec summer scholarship in 1947 (University of California at Berkeley) and a Post-doctoral Research Fellowship from the Rockefeller Foundation in 1950-51 (Harvard University). He started teaching as lecturer in physiology at Université de Montréal (1943-45), and was assistant professor of physiology at Université Laval (1945-55). He was appointed associate professor of biology at University of Ottawa in 1955, full professor in 1958, chairman of the department of Biology in 1962 and Secretary of the Faculty of Pure and Applied Science in 1963 (until 1967). He has been N.R.C. delegate to the International Congress of Physiology (Brussels, 1956), and invited to the International Symposium on Cold Acclimation, held in Buenos Ayres in 1959 by the Federation of American Societies for Experimental Biology. He has served on NRC biology selection committee from 1964 to 1967. He has published over 50 scientific papers and

was elected a Fellow of the Royal Society of Canada in 1962. He is also a member of several scientific societies, national and international. He was appointed to the Science Secretariat of the Privy Council Office, as Principal Scientific Adviser, in October 1968.

Hughes, Elwyn Owen. Age 52; Education: B.Sc. Dalhousie University, 1937; M.A. University of Western Ontario, 1939; Ph.D The Ohio State University, 1942. National Research Council: 1942-43, Secretary, Associate Committees on civil and military medical research; 1951-56, Research Officer, Applied Biology Division; 1955, (On loan to United Nations); 1960-65, Research Council Officer. Counsellor (Scientific) at Canadian Embassy, Washington, D.C. Canadian Army: 1943-45—Captain, R.C.A.M.C. Medical Research Directorate. University of Oklahoma: 1945-51, Assistant Professor of Plant Sciences. Atomic Energy of Canada Limited: 1956-61, Biology and Health Physics Division. Science Secretariat, Privy Council Office: 1965, present—Scientific Adviser.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Thursday, January 30, 1969.

The Special Committee on Science Policy met this day at 10 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, this is the second time that the Science Secretariat has appeared before the committee. Dr. Weir appeared during the first phase, when we were interested in more general considerations than we are during this second phase of our inquiry.

Unfortunately—well, perhaps not unfortunately—when you were before the committee the first time, Dr. Weir, I believe it was the only time when I was not in the Chair; I was sick. So, I am very pleased that you have been able to come back today to tell us in greater detail of your responsibilities and our place within the Government scientific community.

This is really an up-to-date report that we will get, because there have been some recent changes in the functions and responsibilities of the Secretariat, and we will certainly be interested in looking at this new arrangement.

I understand, Dr. Weir, that you want to make an opening statement. Of course, as I am sure you already know, honourable senators, Dr. Weir is accompanied by Dr. J. R. Whitehead, who is a Principal Science Adviser, and also by Dr. Andre DesMarais, who is so a Principal Science Adviser.

Dr. J. R. Weir, Director, Science Secretariat the Privy Council Office: Thank you, Mr. Chairman.

As you mentioned in your introductory remarks, there have been recent changes in the responsibilities and functions of the Science Secretariat, and actually we have been in our present situation since November 1. Therefore, our report today is in

two sections: The first summarizing, if we may, the activities we have conducted since our beginning; and the second, an up-to-date treatise on where we are at the present time, as we see ourselves.

The formal brief to the Senate committee, which has now been in your hands for some time, describes the functions of the Science Secretariat and its present and past relationships to the Science Council and to the Privy Council Office of which it is a part.

In these introductory remarks it is not my intention to repeat this categorization of activities but rather, Mr. Chairman, if honourable senators will permit me, to give an account of the actions and achievements of the Secretariat against this background of organizational and functional information.

After the acceptance of the Mackenzie Report, which endorsed the findings of the Glassco Commission, the Science Secretariat was created in April, 1964 by the appointment of the first director. It was not until May, 1965 that additional professional staff was acquired, in the form of three deputy directors and an executive secretary. Nevertheless, certain of the patterns of subsequent operation were set during that time. For example, a study was made in early 1965 of the future of the Churchill Rocket Research Range.

This study was conducted by a small group of outside consultants and its findings were generally accepted. It became evident, as a result of that study, that a wider examination of the co-ordination of Government activities in upper atmosphere and space research and their relative priorities was necessary. Consequently, this was one of the first subjects chosen as a Science Secretariat special study, once the organization became established.

The period 1965-66 was a formative one in which members of the Secretariat studied science policy activities in other countries and discussed Canada's needs with senior officials

and with the staffs of the Cabinet Secretariat and the Treasury Board. It was during this period that drafting instructions were prepared for the Science Council Act which finally received Royal Assent on May 12, 1966.

During this time, several other studies were either being initiated or planned, namely those on physics, chemistry, psychology and agriculture with basic biology and water resources to follow shortly. It was the intention of the Science Secretariat at that time, in the absence of a Science Council, to provide, by means of these studies, as much background data as possible for the deliberations of that Council and, equally, for the various committees of Government. However, a limited budget, together with obvious practical limitations in its rate of growth made it impossible to pay attention to all fields simultaneously. Moreover, the advice of the Science Council on its interpretation of priorities was not, of course, available at that time when it had barely had time to find its feet. Therefore, the choice of subjects which was rational at the time, may, like many things, seem somewhat arbitrary in retrospect. Details of the various studies undertaken to date are included in the brief already submitted and which is in your hands.

During the year 1966, the Secretariat also responded more and more to specific requests for information and advice on scientific and technological matters from Cabinet committees, the Cabinet Secretariat, the Prime Minister's Office and the Treasury Board. In these respects, the function of the Secretariat was to ensure that not one set of facts or opinions but all those available on a subject in question were called to the attention of those responsible for making decisions. This remains one of the prime functions of the Secretariat in the Privy Council Office.

The need for science and technology to be considered as a major factor in Government policy was just beginning to be recognized internationally at that time. The increasing importance of science and technology on the international scene has led the Department of External Affairs to call on the Secretariat for advice on general scientific issues in international relations. The advice has been mainly concerned with science policy matters over a broad field arising in the Organization for Economic Co-operation and Development, other international organizations, and other countries, and with policies regarding visits and exchanges of scientists with other countries. It is also responsible for advising the

Department of External Affairs on the selection of scientific counsellors for Canadian posts abroad, and for providing guidance and instruction in their work as well as their relocation on the completion of their tour of duty.

The OECD, which had created an ad hoc committee on science policy, organized a meeting of the ministers of science of member countries in January, 1966, which Mr. Drury attended as leader of the Canadian delegation. The Science Secretariat has since participated fully in the activities of the OECD Science Policy Committee—and this is, as you know, no longer an ad hoc body—and has made valuable contacts through it with the leading men involved in science policy in the 23 OECD countries, including the United States and Japan. A common identified problem has been the fact that responsibility for closely related fields of science and technology is often of necessity scattered among several departments and agencies of government. This situation has led to the creation of non-governmental advisory bodies and of coordinating machinery such as the Science Secretariat within the structure of government in most of the major OECD countries.

The Secretariat has also been active in specialist committees of the OECD such as that on scientific and technical information. At the third Ministerial Meeting on Science Policy in March, 1968, Senator J. J. Connolly, the leader of the Canadian delegation, proposed that the Secretary-General establish a high-level working group to advise him on the role of OECD in attacking problems of international transfer of scientific and technical information. This initiative was accepted by the Secretary-General who has recently invited Dr. J. R. Whitehead of the Science Secretariat to represent the Committee for Science Policy on this working group.

The OECD Science Policy Committee also sponsors extensive studies of science in member countries. Studies of the United States, Japan, Sweden, Italy have already appeared. Canada is presently under review as you know. The three examiners, who appeared before this Committee last November, Dr. A. King, Director, Scientific Affairs, OECD, Dr. P. Piganiol and Dr. S. Okita, have toured Canada and have met all the principal bodies engaged in science and technology. Their final report will be presented to the OECD Science Policy Committee at a "confrontation" expected in Paris in mid-1969.

Returning chronologically to the period following the creation of the Science Council in

mid-1966, the completion of the various disciplinary and sector studies initiated by the Science Secretariat was gradually taken over by the Science Council, and others have since been initiated both by the Secretariat and the Council itself. Amongst the most important of these are the studies on University Grants, and Scientific and Technical Information, both of which are shortly to be completed. By far the greater part of the Secretariat's manpower became devoted, directly or indirectly, to the work of the Science Council. Nevertheless, the activities within the Privy Council Office also grew in scope and significance. Perhaps the most important of these was that relating to a domestic satellite communications system.

It became evident in 1967 that there was great interest on the part of the broadcasters and the telecommunications companies in the possibility of a domestic communications satellite. This had been foreseen by the Science Secretariat's Report on Upper Atmosphere and Space Research and also by the Science Council Report No. 1 which endorsed its findings. The Government, consequently, directed the Science Secretariat in August, 1967 to set up a task force on satellites whose first priority would be to report on the subject of satellite communications. The report was submitted and approved in December, 1967, and a White Paper which stated the Government's general policy was published in March, 1968.

At that time, the Science Secretariat was further directed to create a project group on satellite communications in order to further the systems and economics studies and to prepare the drafting instructions for legislation relating to a new body. In the course of this work, missions were sent to Europe and to the United States to investigate potential sources of satellite components and sub-systems and to determine how Canadian launch requirements for 1971 might best be met.

The project group on satellite communications is now in the process of transfer to the new Department of Communications.

The question of a space agency is also within the terms of reference of the task force on satellites although the latter were directed to treat the communications problem as a first priority. Moreover, the question of a space agency must be considered in relationship to the future of various departments and agencies who are now engaged in space activities; the new Department of Communications, the National Research Council, the Defence

Research Board, and the Departments of Energy, Mines and Resources, and Transportation are all involved. It is, therefore, difficult to treat the question of a space agency except as a part of a wider study of the place of interdepartmental scientific activities in government organization.

Since my last appearance before this committee, the responsibility of the Science Secretariat in providing professional, clerical and administrative services for the Science Council of Canada terminated. It should be emphasized, however, that separation of the Science Secretariat and the Science Council does not imply a break in communications between the two bodies. Strong ties are expected to remain and every effort made to ensure that whenever possible the efforts of the two organizations will contribute toward a better understanding of the place of science and technology as an important component in reaching national objectives. For example, when the need for studies of the kind done by the Science Council arises, it is anticipated that the study would be referred to the Science Council.

This separation will enable the Science Council to have greater freedom and flexibility to perform the functions and accept the responsibilities given to it by its Act so that it can become the main public forum for advice to the Government on the broad problems of science, such as how our financial and human resources should be allocated to enhance the country's scientific capability and result in the best economic and social returns. It would also have the freedom to comment, when appropriate, on the role of the university and industrial sectors of the community in scientific and technological matters.

In our view the Science Secretariat is best located within the Privy Council Office where, as one of its prime responsibilities, it can try to ensure, that wherever appropriate, science and technology are harnessed to the pursuit of the Government's objectives. To the extent that scientific and technological input is relevant the Science Secretariat would therefore participate in the determination of government priorities. To this end the Science Secretariat must keep abreast of scientific activities in Canada and abroad, and in particular it must be familiar with the scientific activities within Canadian government departments and agencies and the relationship of their programs to research being conducted in the non-government sectors of the community. Where necessary for this pur-

pose, the Secretariat would expect to coordinate and participate in inter-departmental discussions of scientific and technical subjects.

As in the case of the Task Force on Satellites, the Secretariat does from time to time organize or conduct special studies where necessary so that it can respond rapidly to requests from the Cabinet and its staff, the Prime Minister's Office and the Treasury Board; requests are also made for assistance in dealing with parliamentary questions on science. Another example of this kind of activity was the study on astronomy. At the request of the Government a study group on astronomy was established in June of last year, which after intensive hearings with all interested groups submitted a report which is still under consideration.

A Secretariat function of growing importance is the support that it gives to the Privy Council Committee on Scientific and Industrial Research.

Much has been said recently about the lack of some mechanism or body within the government structure that would be in a position to provide professional and technical support for the planning and initial stages of development, when this is appropriate, on recommendations contained in reports and briefs on science received by the Government from the Science Council or other appropriate bodies. We see the Science Secretariat as being particularly well placed to serve whatever mechanism is adopted, since the Secretariat has no operating or granting responsibilities and can consequently take a more neutral and dispassionate view of science matters affecting departments and agencies of the Government. To some extent, the Secretariat has already been involved in planning. For example, a planning study was an integral part of the report of the Task Force on Satellites which not only considered the scientific and technological aspects of a satellite communications system but also took account of the social, economic, legislative and institutional facets of this question.

In performing this planning function, the Secretariat may be required to initiate plans for new programs and organizations where these are not likely to be generated spontaneously within existing structures.

The functions of the Secretariat that I have just outlined constitute, in our opinion, the major areas of our present responsibilities, particularly the role as a strategically located

organization to assist the Government in implementing its science policy.

I felt it was appropriate to provide this opening statement to cover in general the situation that exists at present as we see it.

Mr. Chairman, you introduced Dr. Whitehead and Dr. DesMarais. I should like to say at this stage that Dr. Whitehead is primarily responsible in the field of the physical and engineering sciences and has been giving considerable thought lately to more general planning. As you know, he has been with the Secretariat since its inception. Dr. DesMarais' interest is in the field of the biological and health sciences, and he has been with us only since last October. I would therefore hope that these two people will participate in the discussion and assist in answering the questions asked.

The Chairman: We will certainly welcome their participation and we expect you to call on them whenever you feel you should. Thank you very much, Dr. Weir.

Our colleague who had agreed to lead the discussion has at the last moment found himself unable to be present, so one of our research directors has asked Senator Grosart to lead the discussion. We all know that Senator Grosart was very active and very heavily engaged at the discussion yesterday, but in spite of this he has agreed to lead the discussion again this morning. If his questions are not as much to the point as they usually are you will understand that it is because he was asked only a few moments ago to come out of the bull pen.

Senator Grosart: Thank you, Mr. Chairman. I might say that I am a reluctant substitute, and my questions will be much shorter and fewer than yesterday.

First of all, Dr. Weir, I should like to say that we all know that a good deal of water has gone under the bridge since you were last here. We had thought at one time of issuing a preliminary report somewhere along the line. I rather wish we had done that, because then we might have taken some credit for the removal of what we discovered as an ambiguity in your terms of reference. However, others have looked after that now, but I hope we can take a little bit of credit because I think we were the first to bring out publicly the fact that there was an ambiguity in your relationship. I remember at the time you were here earlier it was said that you might find yourself under the old dual role of giving

advice to the Science Council which the Science Council might issue as public policy, but nobody would know what the content of your other role as advisors to the Cabinet was in the science policy statement. However, we welcome you back, and I hope we shall be a little easier on you today than we were last time.

My first question naturally relates to your new role, which is indicated on the first page of your brief in the paragraph numbered 2. You describe it as a role

to assemble and analyze information about the government's scientific programs and their inter-relation with other scientific activities throughout Canada.

In a way that seems to be the role of this committee, and I hope you will have more success than we seem to have had in getting definitive answers. I am not criticizing anybody. I am merely saying that out of the mass of information and answers we have had I do not think any of us are yet clear about the status of Canadian publicly supported or privately supported research and development.

Might I ask you to tell us from your experience what in your view constitutes a national science policy; what its ingredients should be; what is its target; what is its purpose; and why, if it is in any way, it is distinct from other public policies.

The Chairman: This is a fairly general question, Senator Grosart, as you will realize, and Dr. Weir can certainly answer it, but we must also remember that he is a public servant and of course he is completely free to answer this question in any way he feels. As far as we are concerned we must remind ourselves that very often public servants should be seen, but not heard, especially on policy.

Senator Grosart: I am well aware of that, Mr. Chairman, but we are glad both to see and I think to hear Dr. Weir this morning and certainly I would not expect him to go beyond his own terms of reference. I think we all know him well enough to know that he would not and I doubt if he would be embarrassed by that question.

Dr. Weir: Mr. Chairman, the question that Senator Grosart asks of course in our opinion strikes right at the core of what we consider to be our major responsibility. I must say that under our new or changed responsibilities, we have had to think about what this is,

what is a science policy as we see it, because I think if we do not do that basically we are going to probably continue to wander a bit in our general thinking.

The remarks I propose to make are really a synthesis of some of the thinking we have done within the secretariat in the last few weeks. One of the main things has been that we have probably had to bring together ideas and thoughts that are generally known and it is a question of looking at it all, but one conclusion we have come to is that the term science policy is used in many different senses and in many different ways. In our view, science policy is not only or even mainly a policy for science and technology as activities separate from the activities of Government, nor is it a policy just for research. It is, as I said, a synthesis of those policies of Government which relate to problems with a scientific and technological content and I think in this sense it is a gross oversimplification to talk of a unified science policy in the same terms as you would talk of a broadcasting policy or a housing policy.

Government scientific activities which are not directly involved with socio-economic and political goals are only a fraction of the total. They are an important fraction, however, because they include the conduct and support of fundamental research which is the foundation of all innovation. In most countries, including Canada, the fraction of the budget so employed lies somewhere between 10 and 20 per cent. It is reasonable I think to speak of a unified Government policy towards fundamental science, especially as most of it is and should in our opinion be conducted outside Government; thus the Government's policy for fundamental science becomes largely a policy for granting purposes.

The reasons for considering together all the scientific activities related to agriculture, transportation, space or pollution are primarily the existence of common popular factors in scientific and technological activities. The greatest of these is the employment of scientists and engineers. The overall science policy must look at this overall problem. These people that form the scientific community are clearly an identifiable group cross-linked by many professional societies. Fed by the university, the scientific community is a dynamic system which continually demands to know where or how it can best serve the nation. Moreover there are scientific disciplines, methods, techniques and institutions which are common to many practical programs and

which are not separated identifiably with socio-economic or political missions.

It is for these reasons that policies for science in various parts of Government, including the policy for fundamental science must all be accounted for in the determination of a science policy. The difficulty lies not only in assigning priorities in the national interest, but in insuring that Government action makes best use of the scientific resources available.

Now, Senator Grosart, I realize I have spoken in broad generalities of necessity, but these are some of the components that we feel must be identified and must be considered in the development of a science policy.

Senator Grosart: I must say this illustrates, Dr. Weir, the advantage of coming back a second time, because you are obviously prepared for the kind of questions that I might ask you. It is an answer that I am sure is going to be very, very useful in our record, because it does cover the whole ground and certainly pinpoints some of the problems that have been raised in our minds.

Dr. Weir: I might say, Senator Grosart, that this is the material to which we have had to address ourselves.

The Chairman: Dr. Weir has brought all his files this morning.

Senator Grosart: I was quite sure you would have been doing some very serious thinking about this now that your role is so clearly defined, and I for one am delighted.

The Chairman: Before you go on, Senator Grosart, can I ask a question more or less in relation to this other one? When I look at page 1 here, when you quote the statement made by the Prime Minister regarding your functions and responsibilities—I do not know if this is the whole statement, but looking at the quotation it would seem that your function is more or less restricted to assembling and analysing information. Do you feel that in spite of this you have also a responsibility, not only in this field which is mentioned here, but in the whole field of science policy including advising the Government on science policy, developing and helping the Government to develop a science policy? Then that would go much beyond what is contained in that quotation there.

Senator Sullivan: Would that interfere with the National Research Council too?

Dr. Weir: Mr. Chairman, in the process of fulfilling the responsibilities within the quotation that is in the brief and that you mentioned, we really had to have some concept of what kind of information was necessary and how this information should be handled and what purpose it is going to be put to, which would compel us to project our thinking into the application of information towards a science policy. That is one side.

The second part of it is the questions we are asked to comment on. The situation we find ourselves in makes it necessary for us to think these things through, so we will have a background, a pattern that we can test our information against and move from there to any comments or advice we might be asked to give.

The Chairman: So you give advice?

Dr. Weir: We comment when we are asked, yes.

Senator Thompson: You assess and give advice. In your opening statement you said you are involved in planning to get the satellite system, and you also said you might initiate plans for programs and organizations. I had the impression that you might, further than the opening statement by the Prime Minister on that assessment, you might lay out the framework by which Government programs could be started.

Dr. Weir: We have been asked in the case you mentioned specifically to do this particular work.

Senator Thompson: I appreciate that about the satellite, but do you go further than that for Government, in suggesting or assessing Government departments, scientific work done in universities, and when you can see there is overlapping or duplication somewhere, you might say that the best kind of results might be if you set up this kind of planning? Would you go to that extent?

Dr. Weir: You know, Mr. Chairman, this was one of the first things that we were faced with before the Science Council was even established. It was the need to comment upon this sort of thing. We felt a very great lack of information on this. That is what originally prompted us to start our inventory studies, to try to get the Canadian picture on science and technology. We really felt there was no reliable information available in one place. It was not our intention, nor is it still, to do this work ourselves. We should not be an operat-

ing unit. We have supported and will continue to support operating units, such as the National Research Council and departments or Government agencies in any part of this work that they are able to do. But we need to have this information focussed in one place so that when we are asked for information we can respond as accurately and as objectively and as thoroughly as it is possible to do.

We are in this world of getting information from the sciences, or from the departments in Government, getting information that comes out of the studies from the Science Council, who have taken over the job we started before it was there, and we are interested in information and reports from universities and industrial sectors. We must be conscious and aware of these, and this is what then carries us a step further to look at these in the context of some science policy.

Senator Sullivan: Do you advise, or do the various agencies, such as the National Research Council, the Defence Research Board, the Medical Research Council—do they consult you, or do you advise them to undertake certain projects?

Dr. Weir: No, we do not. We are not involved in the operational side of their activities.

Senator Sullivan: I realize that.

Dr. Weir: There is discussion from time to time, whenever it seems appropriate, with officers of these organizations, yes.

Senator Sullivan: Thank you.

Senator Hays: On page 19, water resources, we mentioned this before when we had other witnesses. Who initiates the studies on the need for water conservation?

Does the National Research Council say, apropos what Dr. Sullivan had to say—do they say “well, we should be spending more money in this field” or do you, or how are these studies initiated?

Dr. Weir: The studies pertaining to water resources research?

Senator Hays: Yes.

Dr. Weir: There is an interdepartmental committee on water resources. I think it would be appropriate if Dr. DesMarais would very briefly comment on the water resources picture, as he has had some association with it.

Dr. André DesMarais, Principal Science Advisor, Science Secretariat of the Privy Council Office: Mr. Chairman, as you are certainly aware, the Science Secretariat had undertaken two years ago—I think in 1966—a study on water resources research, a special study which was followed by a recommendation for a major program in that area by the Science Council. You will excuse me if I make some mistakes, as I am very new in this business of Government operation.

The Chairman: You mean, it takes a long time to know it?

Dr. DesMarais: Yes. The water resources research has been in the Department of Energy, Mines and Resources, which has the prime responsibility for water research in the Government. This report of the Science Council is now under consideration. However, the responsibility for its consideration is still rather flexible in the sense that although we do not have an organization for looking at science in that way, the program has been under review by the interdepartmental committee on water research, naturally.

Senator Hays: Let us take India or California as a good example. We project our population, we will know that in X number of years it will be 50 million. We know what problems these people have gone through in these older areas. It seems to me there is a great lack of information and initiation of things which should be done. I am wondering if this is the job of the National Research Council or whose job it is to do these things before they creep up on us.

Dr. Weir: Mr. Chairman, this is the responsibility of the interdepartmental committee, which has representation on it from the departments with major interests in water and is under the responsibility of the Department of Energy, Mines and Resources. This interdepartmental committee is being reconstituted at the moment to involve a wide advisory group, so I would expect you would see a much broader and more intense look at the problems associated with water in the future.

Senator Hays: You mentioned the task force of OECD. In their collection of material, would this be helpful in resolving some of these problems? For example, in Hamilton we knew it was going to be polluted 30 years ago, but we did not do anything about it. We knew a long time ago when we were drinking wine in France that it was because we could

not drink the water. It seems to me we let all these things creep up on us.

It seems that in all these fields we get hit right in the face with a problem before we do anything about it. I suppose this is part of the responsibility of the Science Secretariat or the National Research Council.

Dr. Weir: This is now the responsibility of the Interdepartmental Committee on Water Resources.

Senator Hays: Yes, I know.

Dr. DesMarais: I think we realize now the great importance of inventory studies in any major field. If one looks at this report on water resources research one will find that there is one aspect of science policy which could be called co-ordination in planning, because such a study, through an inventory of the situation, brings in all specialists in the field of water research and all aspects of it. This survey of water being done in Canada is, therefore, evaluated against what is being done somewhere else and against the problems we have. So the very fact of assembling this data and information is already the first step in formulating a program of research. This is extremely important.

Senator Hays: Just looking at another field, that of transportation in large cities, surely it should be possible for city councils, and so on, together with the various planning departments, to prepare themselves for population growth and increase in traffic and the problems of transportation. Small cities must realize that, eventually, they are going to have the large problems of transportation facing cities such as Toronto today. If they have a population of 200,000 now, they know that in a few years they are going to have a population of, say, 600,000. Yet no provision seems to be made for land acquisition and the sort of thing that is necessary to plan for such a growth. There does not seem to be any interest in the type of information that could be helpful, but perhaps the city should be given the information by some group which would tell them, "Well, you will run into a great many problems if you do not do so and so".

The Chairman: I understand that Mr. Helyer is going to solve that problem.

Senator Hays: Well, it is a very great problem. You know, if you are going to have a subway in X number of years, why not make

provision now for the acquisition of the necessary land and plan where it is going to run? Another problem has to do with sewage. Cities must go down river, and yet they are being built up river. The city knows that in so many years it is going to have to put a sewer down across the middle of the city and that it is going to cost them a great deal of money. Information on these things is available now, but it is not being passed on. I am wondering whose responsibility this is.

Dr. Weir: Mr. Chairman, Dr. Whitehead might have some pertinent comments on this question.

Dr. J. R. Whitehead, Principal Science Advisor, Science Secretariat of the Privy Council Office: If I might attempt, Mr. Chairman, a very direct answer to what I understand is the sense of the question. I think it is the responsibility of the Secretariat to call attention to these problems and to arouse interest, just as it is, in a perhaps earlier and broader sense, the responsibility of the Science Council to call public attention, both that of the Government and that of private enterprise, to these problems of urbanization and transportation. Certainly, they should attract the attention of the Government, if not in the sense of action, at least in the sense of ensuring that those who might take action are aware of all the considerations and all the facts.

This is a part of the history, and we come back to it again, of the satellite communications project, where, in fact, the initiative in terms of enthusiasm was taken in this way.

Senator Hays: Are you set up to give this sort of advice? Do you have the information, even if you were asked for this sort of advice? Let me give you an example in my own city, Calgary. We have two rivers, both swift-running; we have prevailing winds of about 15 or 16 miles an hour blowing to the east all the time. We have a ward system in which a couple of strong members have started taking the town in the wrong direction, and you can just see where we are going to have to spend something like \$15 million on a 12-foot sewer to run it downtown, when there was no need to go away from the river in the first place. They are taking their water from above, of course, which they have to do, but when you have a situation like that, and this has been proven in cities all over Europe, you go down river because it is economically sound. Otherwise, you end with the unit not sound enough for the purposes of industry

and they no longer compete, and taxes get out of hand.

Many cities do this sort of thing, it seems to me, and there is advice that could be given to them or studies that could be initiated and so on.

If you are going to have a million people in your city, there are ground rules that you are going to have to obey or you are going to get into trouble. It would be better to obey them than to just fumble along.

Dr. Whitehead: I think this illustrates very pointedly the value of detailed background studies by experts. It does not happen that one has been initiated in urbanization, although I believe the problem has been discussed in the Science Council.

But in many other fields, as you are aware, including water resources, this kind of study has been done, and I think perhaps the illumination of public awareness, the increase in public awareness of the problems, is probably the first and biggest step in ensuring that the right things are done.

Going back to your earlier side-question, no, we are not omniscient. That is, we do not have all this information, but this is the purpose of many of the specialized studies, most of which are now in the hands of the Science Council and all of which we are extremely anxious to have and to use for this purpose.

Senator Grosart: Mr. Chairman, the discussion we have just had points up a very significant phrase that was used by Dr. Weir in his introductory remarks. You used the phrase, "whatever mechanism is adopted". You were referring to the fact that we had been discussing this problem of mechanism.

You have the Science Secretariat with certain responsibilities, the Science Council with others, and there are many other bodies including the NRC. Of course, this points up the fact that co-ordination and inventory studies are obviously not enough. Somewhere there has to be a mechanism of control. I am not going to ask Dr. Weir whether he thinks we should have a minister of science policy. He said "whatever mechanism is adopted" and my understanding is that the main function of the Science Secretariat will be to advise and counsel that mechanism, whatever it is, whether it is a supervisory committee of the cabinet or a cabinet minister.

Now you have referred to inventory which is obviously an essential first step before any

real sound advice can be given. Would you indicate the status of the inventory at the moment? If I may make clear what I mean. Taking only that sector which is concerned with the spending of public money, we have, as we heard yesterday, a thousand projects under way in the NRC; we have probably another several hundred, if not another thousand, under way sponsored by departments, and we have another large number under way in universities with different kinds of funding.

Now, we have asked the question here on a number of occasions, for example in the university sector where departments are giving grants or where an agency gives a grant—"When you decide to give a grant to XYZ university for a specific purpose, do you know what the other departments and agencies are doing?" And the answer has invariably been "No." So we have been faced with these ad hoc decisions and the result is the imbalance that your secretariat has told us about. They have pointed out that our whole R & D effort is out of balance in certain ways. One of your statements in the report has been that all in-house government research in the university sector is not too good, and it is completely unsatisfactory in the industrial sector. This is a statement I read in the report. Obviously there has to be an inventory. I am speaking now of government spending. Somebody has to look at it and say "Does it make sense? Does it make sense for the NRC to be doing this particular kind of project?"

Again you spoke of a role you may have in developing the spontaneity of research. This means, I suppose, that one of our roles is to look at the gaps and see where the gaps are. We have asked the Science Council what their role was in advising the Government and they said "Ours is long term; nothing to do with short term." So, first of all I would ask you what is the status of inventory, and who do you see giving the ultimate decision-maker, which is the cabinet, the short-term or day-to-day advice?

Dr. Weir: Well, Mr. Chairman, my answer to the state of the inventory probably will not satisfy Senator Grosart at this time since practically all the inventory studies as of last November are now the Science Council's responsibility. It comes under their supervision. So that an up-to-date picture of where they stand is there. Now I am certain I can comment generally on it, and I am certain we could provide you with the detailed timetable

of when these inventory studies are going to finish, if that would be satisfactory.

The Chairman: Do you not think in this regard that first of all the field is very wide and you seem to have gone very slowly? I am sure it is not your fault. Perhaps lack of support, of personnel, of staff and of money have something to do with it. But the process of inventory seems to be going very slowly. What worries me is that we are in a period when things move very quickly so that when some of the studies are terminated, or very shortly thereafter, they are already obsolete. I wonder if when you make a study and publish a report there is some kind of mechanism by which you will continue to gather the information in that field so as to keep it up to date, or if you leave that study, for instance on physics in Canada, at that point. Was this a one-shot operation? Is it prepared and then forgotten about? Because if there is no follow-up to gather current information you almost always lose time. It might be very interesting for the historians but not for the others.

Dr. Weir: I would like to make one general comment and then I would like to ask Dr. Whitehead to comment on the physics study and one or two other studies he has been more closely associated with. My comment is that this has always been a concern of ours since we started the inventory studies, first because of their magnitude and the scope they cover. It did involve for the first time looking at government, university and industrial sectors and getting information on techniques and methods in Canada. The various organizations were not accustomed to this so there was some delay. We were also concerned with the point you mentioned that this would be done just once and would very rapidly become out of date. We didn't see ourselves as an operating unit to continually do studies of this kind because this is a very large operational activity. It is one of the reasons why we attempted to involve professional organizations in these studies for us because we thought this would activate them and they would have an interest in them and would attempt to carry them on. In some instances this has been evident and has been done.

Secondly, we have been concerned about trying to locate the appropriate place in which such information would be continually kept up to date because I think this is the key or the core of our decisions. This is what we

were faced with in our first month in the Secretariat. Lack of this background knowledge prompted us to start on these studies.

Dr. Whitehead: Mr. Chairman, if I might complement Dr. Weir's remarks in answer to Senator Grosart's question in a rather broader sense and not restricted to the inventory studies or the techniques already employed. I think the question does bear on a vital component of government decision-making, the background information. Inventories, I think, have little value per se but they are an essential background, something you notice remarkably if it isn't there and it certainly is not here in a comprehensive sense at the moment, as you say.

It does bear on the whole broad question of information for Government decision making, not only in science and technology. However, restricting it to science and technology, I have recently had, as you know, the privilege of discussing in the international forum the question not only of the dissemination of scientific and technical information, but also discussions which tended to centre on the dissemination, for the purposes of decision, of information about science and technology, which is a slightly different thing; that is, not information with a scientific and technical content, but information describing what is being done both qualitatively and quantitatively. Here, perhaps, there is a faster process than the detailed studies that can be imagined, more of a cataloguing process, without losing the qualitative factor, the descriptive factor.

Senator Grosart: The qualitative factor is an essential part of an inventory?

Dr. Whitehead: I think perhaps it is not always realized to what extent detailed information is required, or access to selected parts of it, for really quite high level policy decisions. Because of the immense complexity of the content of this information, as you, sir, described, it leads one immediately to think of computerized storage and fast processing systems; and this we are discussing quite actively.

Dr. Spaey, who spoke to this committee late last year, has perhaps had more success than anyone in setting up in his own country such computerized storage, including the essential kind of information you describe; and, due to his extreme co-operation, we have all the details of his system, including copies of all the relevant papers, procedures,

questionnaires, and we are studying them very carefully, to see what their relevance is to our own problem. I think it is probably very great. He operates this system with very great economy, with very few people involved, without enormous resources—though our problem is, of course, proportionately bigger because of our greater scientific budget.

The Chairman: I understand, then, that up to now these inventory studies which have been made have been, for all practical purposes, one-shot operations, and that there has been no real follow-up and there is no continuing operation to accumulate up-to-date information.

Senator Grosart: I wonder if I could stay with this particular question for the moment, Mr. Chairman?

I think we have to assume that in due course there will be a Canadian inventory. I think we can also assume—

The Chairman: Continuing.

Senator Grosart: No. Just let me go one step at a time. I say that I think we have to assume there will be an inventory made, that it will be adequate and up to international standards. Assuming that inventory is made, what control will there be of the future input into that inventory?

For example, I mentioned the thousand projects at NRC, the input of public money—and I am only speaking of that public money, at the moment, to hold the discussion within reasonable limits. Will the Science Secretariat know in advance the intention of adding to that inventory from public money, from any source? Will you know in advance, Dr. Weir; or do you expect to know, or hope to know in advance; or do you think you have the right to know in advance?

The Chairman: I do not really understand your question, senator. When you say “inventory,” you seem to mean rather the projects that NRC intends to undertake.

Senator Grosart: That is part of the inventory. The inventory, from an accounting point of view, is the detailed expenditure of public funds on R and D; that is the inventory. You ask, “Where is the money being spent?” You look at this and say, “Are there in this any overlappings?”—and that is an obvious part, and I know that will be done. However, any expenditure of public funds on any project

adds to that inventory, the inventory of R and D performance in Canada.

What we are all interested in knowing is: Is there nothing put in the mechanism to control the future input?—because the evidence we have indicates that all these ad hoc science policy decisions being made all over the place have put us in a very lamentable position, as the OECD has pointed out. We are at the bottom of the list in many of these things.

The Science Secretariat was only set up in 1964, and the Science Council in 1966. Knowledge of the problem was so little that we started off with a major error, which we have now corrected by separating the two functions. It is the best example in the world; somebody did not take the necessary steps to set up the Science Secretariat and Science Council and make sense of it. I am not criticizing that; we are new in this business: I am concerned about the future. Is a function of the Secretariat possibly to go and advise somebody that this should or should not be put in the mechanism? Do you see this as a function of the Secretariat? I think you do, from your report.

Dr. Weir: Mr. Chairman, if the Secretariat is going to be the professional body for the mechanism that is set up to discuss science and science policy, it would require to have this information to perform this function.

Senator Grosart: In advance.

Dr. Weir: Well, yes.

The Chairman: But at present you are not being consulted by these agencies in the preparation of their research programs and budgets.

Senator Grosart: I think the present situation—and Dr. Weir will agree—is that all of those who are spending public money on R and D do not appear, at the moment, to be required to notify the Secretariat in advance, so it can advise them or the mechanism.

Senator Hays: This information is all available. Regarding all the things that have been done in science, particularly where public money has been used, there are ways of finding out all this information, are there not?

Dr. Weir: Certainly after it has been done.

Senator Grosart: That is the point.

The Chairman: For historians!

Senator Hays: But it is available from year to year. The inventory of the past should not be that difficult to obtain; and, if you have that, where the future looks a great deal brighter...

The Chairman: If the information seems to be readily accessible, even that part seems to take quite a lot of time.

Senator Grosart: Of course, the difficulty here, Mr. Chairman, is that you can perhaps very easily get a quantitative inventory but, as Dr. Whitehead has said, that is useless unless you are able to say what this name over a project really means.

Dr. Whitehead: I would like to take up what Senator Grosart has said, Mr. Chairman, in the sense of the question: "Do you have access in advance to these; do the departments tell you?" and such questions. I would just like to go back to the point of imagining a central data bank, a central inventory of science. This would, of course, be of immense use to the people who are making decisions within the departments and agencies themselves. Perhaps it would be of more use to them than it would be to anyone else. Therefore, it would probably, I would think, be in their greatest interest to create it and keep it up to date. So, I would rather look at the process as a process of initiation from inside, which has not yet occurred. I think that this is the proper way of doing it.

The Chairman: But do you not think in this case that you would need a sort of central organization? If each individual agency does this for itself perhaps it will know better than it knows now what has been going on inside, but other agencies will not know what has been going on inside.

Dr. Whitehead: I was assuming that all of this information would go into a central point, or a central organization.

I should like to add to your remarks, Senators Hays, on the problem of getting access to existing information, that while it is always possible, or generally possible in any one field or one project, it is enormously complicated, and it involves the use of tremendous resources in terms of manpower.

Senator Hays: I can understand that, but I can think of no body that has as much power as you have to dictate some of these things, because you are in the Privy Council Office. If the Prime Minister says: "If we are going to function properly we must have these

things", and he cracks the whip, why, you have that information. You can say: "If we are going to function properly we must have it".

The Chairman: Within the Government that would be easy, but that does not mean it would make things necessarily easier outside the Government.

Senator Hays: That is right, but Senator Grosart was talking about within the Government. You are advising the Prime Minister. He is asking your advice in so far as—

The Chairman: This is exactly the point. I am still confused about this, because you told us that one of your functions is to assemble and analyze information. If this is the situation then I would say that I do not see any advisory function in that kind of statement. Where is the authority, or when were you assigned the responsibility, to advise cabinet committees and to advise the Prime Minister on science policy and science programs and projects? What has really been the improvement that has occurred since the organization of the Science Council? We still have two advisory bodies advising the same people.

Senator Grosart: Two?

The Chairman: Two in this very specific field. It seems to me that the only net result of this new arrangement has been to transfer some people from the Secretariat to the Council. The first studies were made by the Secretariat, and now the Secretariat will ask the Science Council to make them. I do not see any improvement. I am glad that Senator Grosart is more satisfied than I am, but it seems to me that there has been no real improvement in the lines of communication, or in the division of labour, as a result of this new arrangement.

Senator Thompson: May I add that it seems to me from your remarks and those of Senator Grosart that you are hoping there will be a mechanism set up to which you will give advice. As I understand it, in your opening remarks you said that there is a lack of a mechanism, or a Government body, for making decisions, but that when there is you will be prepared to serve it. In other words, it is not a case at this point of advising the same body as previously, the Science Council. I interpret your remarks as saying you are not quite sure whom you do advise, and you are hoping a mechanism will be set up.

Dr. Weir: Might I make one or two comments, Mr. Chairman? First, regarding your reference to the quotation in the brief, I would point out that that is a quotation from the then Prime Minister, in which he said...

The Chairman: Yes, I understand that these were your terms of reference.

Senator Grosart: A small part of them.

Dr. Weir: This is how he described what he felt were the functions the Secretariat should perform immediately. We have got to operate, I think, as any of the other sectors of the Privy Council Office, since we are members of the Privy Council Office. Therefore, we have all the constraints and restraints of a Privy Council Office activity. Because we are subject to requests to do, and comment on, certain things...

The Chairman: I was in the Privy Council Office before, so I can see your point.

Dr. Weir: If the requests touch on these general questions then we have to be prepared to meet them.

The Chairman: So, this quotation from the former Prime Minister really does not at present adequately describe your responsibilities, or what you are doing?

Dr. Weir: I would hope, Mr. Chairman, that the references I made in the latter part of my introductory remarks might more clearly define our present sense of responsibility.

The Chairman: So you not only inform and comment on various projects and all that—having regard to your responsibility in the international field—but you also advise the government on science policy.

Dr. Weir: When asked, yes.

Senator Grosart: Mr. Chairman, I think it is only fair at this point to remind ourselves that there is a distinction between the Privy Council and the Privy Council Office, which is very often forgotten when we are discussing these matters. I said I appeared to be more satisfied than you are...

The Chairman: I can tell you that the Privy Council does not meet very often.

Senator Grosart: I shall come to that later on, but I am perhaps more tolerant, and certainly much more hopeful than you are that the Science Secretariat is going to solve a lot of these problems...

The Chairman: I did not say that.

Senator Grosart: No, but you were speaking of my satisfaction...

The Chairman: Yes, with the new arrangement.

Senator Grosart: Yes, I am satisfied that the new arrangement is much better than the old one, and from reading this report and Dr. Weir's comments, and the comments of others, I am satisfied that the Science Council is fully aware of the problem, and it is only a matter now of the making of the political decision to set up the mechanism which will give them more than an advisory capacity, or which will give them access to control in the whole function.

The Chairman: To the decision-making function?

Senator Grosart: ...to the whole science policy decision-making function. I do not think we should carry this too far until we see what happens. Everything depends upon the setting up of this mechanism, whatever it may be.

This brings me to part of the mechanism which we will find indicated at page 4, where we read:

The major cabinet committee concerned with science is the Privy Council Committee on Scientific and Industrial Research

and later on we read that this committee is advised by the advisory panel on scientific policy consisting of the deputy heads of the science-based departments of the Government.

The indication here is that for obvious reasons the Privy Council Committee has not functioned aggressively. I think that is the word here.

The Chairman: You mean the Cabinet committee?

Senator Grosart: The Cabinet committee. But it is the Cabinet Committee on Scientific and Industrial Research. Dr. Weir has indicated that there are plans by which this committee will become more operative. Could you tell us a little bit about this because this is part of the control mechanism?

Dr. Weir: We consider at the present time that the Privy Council Committee on Scientific and Industrial Research is the mechanism within the Government...

Senator Grosart: These are all Cabinet ministers?

Dr. Weir: All Cabinet ministers who have a responsibility for large important scientific activities. We consider that to be the present mechanism to which we address ourselves on matters of scientific and technological problems. We also consider that the chairman of this committee is the spokesman for science and technology, by virtue of being chairman of this Cabinet committee. In my introductory remarks I said I did not feel it was appropriate for the Secretariat to go further than to say that whatever mechanism is decided on we feel we are in a position to have the organization to service such a mechanism. What I am saying now in answer to your question is that at present we are using this committee as the existing mechanism. We feel that if it is provided with more background information, which we should be in a position to do, maybe there is more reason for it to meet the problems of science and technology.

The Chairman: But at present let us say you service this Cabinet committee. You presumably advise the chairman of that committee on the main issues, so you are really advising the Government in the field of science policy. What is the distinction with respect to this function, the division of labour between you and the Science Council with the new arrangement, with respect to advising? Do you function on parallel lines or do you have an advising function which would be different from that of the Science Council?

Dr. Weir: With respect to the Privy Council Committee on Scientific and Industrial Research, we function as any other part of the Privy Council Office functions with respect to a Cabinet committee in giving it background material. The Science Council as a public body has its own ways of advising ministers. We are the part of the Privy Council Office that has a specialty in science and technology to service this committee, as other Cabinet secretariats do to other Cabinet committees.

The Chairman: But do you not have two fields of advising? You advise on anything you are asked for, and the Science Council does the same.

Senator Grosart: Dr. Weir, you used the word spontaneity, spontaneity of initiative on the part of the Science Secretariat. May I ask you this specifically; when the inventory is reasonably complete would you see it as a

function of the Secretariat to look over programs and projects of the National Research Council, the Medical Research Council, the Defence Research Board, IRDIA in the Department of Industry, PAIT, and all these other agencies that are initiating R and sometimes D? Would you see it as your function to look over these and then say to the mechanism, whether it is the present committee, the minister of science policy, or whoever it may be, "We should take another look at these 1,000 projects in NRC. We think there is overlapping. We think the Defence Research Board is going too far in this direction"? Would you see it as your function to initiate this kind of examination of the inventory and then on your own to advise the Cabinet? It seems to me that unless the Cabinet gets this kind of advice somewhere we will not have a national science policy.

Senator Sullivan: I do not think the Science Secretariat could do that.

Senator Grosart: Dr. Weir will tell us.

Senator Sullivan: I do not think they could, as one who has been interested in medical research.

The Chairman: Let us have the answer, if there is one, then you will be able to give your own views on your report.

Senator Sullivan: How can they judge, for example, whether the project under the National Research Council for this ear defender was a good one.

Senator Grosart: Somebody has to.

Senator Sullivan: Well, they cannot.

Dr. Weir: This, of course, is a very complicated question. Before I comment specifically on Senator Grosart's question, I think I might say that we still may have to look at the organizational structure within government for scientific and industrial activities to see whether it might be possible to focus attention and do this evaluation at a level above the operating departments and agencies in which these things are split around in the different areas. Really what you are saying is that an evaluation committee, an evaluation group or an evaluation council that can look at major areas of government and identify...

Senator Grosart: To sum it up in one word, control, control of public spending.

Dr. Weir: I think the Secretariat has to be careful, on the one hand that it does not get

itself involved in the control of research and technology that is in the government departments and agencies, and on the other hand that it be in a general advisory position once the evaluation has been done and the recommendations made, because one would be sort of judge and jury in this case. I think there is here an area which still has to be looked at to see if there is an additional mechanism needed to do this evaluation. I would be hopeful that out of some of the studies, which are now well advanced, such as the Macdonald study on federal support of research in the universities, or the information study, or some of these other studies that are crystallizing, there might come identified means and structures by which this sort of thing could be done on a continuing basis.

Senator Grosart: Dr. Weir, I am assuming that there is or will be control of a national science policy. I have to assume that; I cannot believe that we are going on without control of this policy. I do not care what the control is at the moment. My assumption is that you will advise that control body. My question is: will you initiate advice or will you merely wait until that control body asks you for advice?

The Chairman: This is a hypothetical question.

Senator Grosart: It is not a hypothetical question. I am assuming there is a control body at the moment and that the Secretariat is the adviser to that control body. I have to assume this; I cannot say here that I believe there is no control and that the Science Secretariat is not advising whoever the controller is. I am just asking, will you initiate advice or do you initiate advice?

The Chairman: That is better.

Dr. Weir: I would say, Senator Grosart, it would be necessary to initiate advice at an appropriate time.

Senator Thompson: Could I return again to the Science Council? The Science Council is advising the Privy Council—they have certain projects.

The Chairman: Advising the Prime Minister.

Senator Thompson: I am sorry certain projects in the past that should now be given priority. Do you come in as a group? For instance the Prime Minister turns it over to you and says, "Give me advice on this."

Should we follow up in this particular project that the Science Council are advocating?

Dr. Weir: This, Mr. Chairman, is a possibility. If he did we of course would have to act. The other side of the picture in a way is the implication of advice being given by the Science Council on broad issues to Government organizations and existing programs. It has to be looked at as to what it will mean and what it will do to the present program. This, I would think, involves the use of current privileged information and a look at the business.

The Chairman: Let us take a specific example. I certainly do not want to know the content of the advice you gave. I would just like to know if you were consulted when the Government in recent months reallocated a number of research functions within the federal Government. You are free not to answer, of course.

Dr. Weir: I would prefer not to answer in this case, because it is a problem of identifying "if" and not "you were". It comes up in many instances.

Senator Thompson: I would like to follow with Senator Sullivan's question. Some surgeons come before the National Research Council. They would like to get help on a study regarding the brain cooling machine.

Senator Sullivan: They are good projects too.

Senator Thompson: Senator Sullivan, I think you should take the ball from here, but I will follow it up. They go to NRC. If this was a major project of about \$5 million I would presume it would be referred to the Medical Research Council, eventually again with the allocation of funds. This comes up to the Privy Council or I would think to the Privy Council and to the Treasury Board. The Treasury Board says there is an allocation for funds for brain cooling. They also seem to want to get into kidney research or something. Now, we have not got enough funds for both of these things. Who makes the decision on where the funds go to? Do you advise the appropriate mechanism? I do not know who it is. I imagine it is the Cabinet or the minister of Government.

Dr. Weir: Mr. Chairman, we have had instances of requests referred to us for advice or similar issues of this kind. I have no way of knowing what proportion of these requests

have been referred to us. If it is a question of Treasury Board it is a question in which I would not have the information in order to answer.

The Chairman: Normally the agency involved for initiating the project—in this case the Medical Research Council—would not come to you and ask you if it is a worthwhile project. They would go normally through their minister to the Treasury Board—we know all the different levels of consultation—and then perhaps occasionally the Treasury Board would come to you?

Dr. Weir: That is right and the initiative I think should remain in the responsible department, an agency for coming forward with these suggestions.

Senator Hays: It is up to whoever puts up the biggest fight to the Treasury Board.

Senator Grosart: On the other hand, you made some very specific recommendations—the Physics Report No. 2. You say the total expenditure here—and I am not sure whether you are referring to Government expenditure or total national expenditure on physics—should rise at the rate of 23 per cent per year. This is a pretty specific recommendation. This was in your report, was it not?

The Chairman: Perhaps not in that one, but certainly in one on water resources.

Senator Grosart: Give me a moment and I will find it.

Senator Sullivan: I think that is appropriate for physics, but not for psychologists.

Senator Grosart: Page 12, paragraph 33, dealing with special study No. 2, "Physics in Canada, Survey and Outlook". The direct quotation is as follows:

It finds that the present overall growth rate is a great improvement over the level in the past and suggests that the normal expenditure on physics research should rise at a rate of 23 per cent per annum.

We are making a difference between 23 and 25 per cent per annum and it certainly must be quite specific. I am all for this; I am not criticizing.

Dr. Weir: I think there are some points that should be clarified here and I might make a comment. Dr. Whitehead is much closer to this field. This report or the brief we present-

ed to you gave a summarization of the studies we have done and this is a quotation from that, but these reports were the independent reports of our study groups. If you look at the reports of the study groups, you will see that there is a disclaimer, because this is not the Secretariat's or the Government's recommendations, but a recommendation of the study group.

Senator Grosart: Excuse me, who is "it"? "It finds" and "it suggests".

Dr. Weir: The report.

Senator Grosart: Who sponsored the report?

Dr. Weir: The report was done under the sponsorship of the Secretariat by a study group who published its own recommendations.

Senator Grosart: Are you saying that the Science Secretariat, publishing a report of the study group, does not necessarily endorse it?

Dr. Weir: Not at the time we were doing these inventory studies and staff work.

Senator Grosart: That certainly adds a bit to the confusion.

Dr. Whitehead: Mr. Chairman, I think the physics report, like the space report, is characteristic of a number of things for early studies. Whether the policy was right or wrong, I think it had some virtues because it was the first time a group of experts had been commissioned to prepare a report. It is, of course, always difficult to get together a group of experts and have them prepare a report without putting in recommendations. However, the report was published as a background paper to the future expected deliberations of the Science Council. It was presented just as that and made very clear in the preface to the report and the introduction to the report. It is a background paper. Then, in the case of the space report, for example, this was considered by the Science Council, which then produced its own report, which was again published. At the time the Science Council discussed the background report the Chapman Report, as it is now known, they had available to them not only the Chapman Report but press and public comment on that report, which was very valuable to the Science Council in its deliberations.

When the Science Council had completed its discussions it published its own report, which was again a public report, and the

Government in receiving that report again had the public and press reaction to the Science Council recommendations.

We believe these are extremely valuable stages or checks.

The Chairman: As a result of that, there was a White Paper published.

Dr. Whitehead: There was a task force report on satellites, and a White Paper on satellites.

Senator Grosart: Were any of the reports published under the authority of the Science Secretariat, recommendations of the Secretariat?

Dr. Whitehead: No.

Dr. Weir: No.

Senator Grosart: Not even the ING Report?

Dr. Whitehead: No.

Senator Grosart: This was a study you passed on?

Dr. Whitehead: The ING Report was a study on behalf of the Science Council in this particular instance. The terms are explained in the introduction.

Senator Thompson: On this report being published—I am thinking of ING—if you think of capital punishment, for example, before a Government decision is made there are the pros and cons and these come before the public either through *Hansard* or other sources. There are the public and parliamentary decision-making people who know the pros and cons. When it comes to some important scientific decision, I am thinking of ING, the report just gives one side, as I read it. We understood later there were two sides. Would you feel it would be of benefit, not only to the advice to the Prime Minister or the Privy Council, but I am also thinking of the general public—if, when these reports were published, the pros and cons were available so that it would help the public or scientists or lay people who, after all, are going to make the decision, so that they could get a confrontation of two points in order to make the decision?

Dr. Weir: I think I agree with your philosophy on this. The ING study was of a separate nature from the other reports which we had, and Dr. Whitehead may care to comment on that. Our philosophy at the beginning, rightly or wrongly, was that we should involve as

many of the scientific community in the background studies that we were doing as it was practicable and reasonable to do, so that we would get a broad point of view, and it would give them a sense of participation. Then, our purpose in publishing their report—with a disclaimer on it as to policy implications—was to get back into the community a discussion of Canadian science and science problems. We thought this was necessary.

This has led to a number of implications and problems, quoting us as recommending from a background paper, which we just wanted to get out for information. In general, we want to get every point of view, every viable point of view, exposed. This is why we followed the practice of publishing reports of these committees, without any editing, other than whatever was necessary for preparing them for publication. But ING was separate. Perhaps Dr. Whitehead will wish to comment more on this.

Dr. Whitehead: Perhaps there is not much more to say, except that the ING Report was prepared in response to a request to the Science Council and the Secretariat was involved in providing staff to assist in this, for comment on the ING project.

It was a report, essentially, of a committee of the Science Council, not in any sense a report of the Secretariat, nor a report done in the way the others were done.

Senator Grosart: Were there not two reports—one by the Secretariat and one by the Science Council?

Dr. Whitehead: Yes, there were two reports—one was by the Science Council and one was sponsored by the Secretariat for the Science Council.

Senator Grosart: You say one was sponsored by the Secretariat and one by the Science Council, but was it not a Secretariat report?

Dr. Whitehead: One—both were reports of the Science Council Committee—one was a detailed report and one was a background report. In the series in which they were published, the Secretariat provided the staff to support the Science Council Committee, to support the writing of the report, and the detailed report was published by the Science Council.

Senator Grosart: Then you had the reports from the Associate Deans of Engineering,

which was countered by other associates of the associates.

The Chairman: Am I right in saying that under the new arrangement the Science Secretariat will not publish any more of these reports?

Dr. Whitehead: This particular series has been taken over and will be continued, with slight modification in the cover, by the Science Council.

Dr. Weir: As a matter of fact, the last two reports, I believe, have come out under these background papers for the Science Council.

Senator Thompson: Perhaps you will not want to comment on this. I am thinking of the mechanics of it. You may not want to comment, because this will be something outside, I presume to be decided by the Cabinet and the Prime Minister. What type of mechanism is there? I am concerned as a layman, and having learned a lot from sitting in this Science Committee, that the public needs to be more informed, or try to become more informed, on general decisions concerning subjects like this, in view of the enormous outlays.

In the United States they seem to have a congressional committee. In other countries, I notice there is an approach of confrontation of two points of view, which are presented to some intermediary committee of representatives or other people, before it finally gets to the Cabinet. I would presume that the advice concerning the confrontation is made by some committee, some body such as yours, to see that the representatives—I am thinking of members of Parliament or of Congress—are getting the full picture and you are the best people to present this? I do not know if you want to comment on that.

Dr. Weir: Only to the extent that we interpret our role relative to the Privy Council Committee on Scientific and Industrial Research, so that they get all the points of view and all the various facts for their deliberations. I think this is part of a professional and technical responsibility, to try to bring this material forward.

Senator Thompson: Similarly, I think that advice has been given to Cabinet, decisions made by Cabinet, and it seems to me we need an intermediary decision so that the public can become more informed. I am thinking in terms of some kind of committee.

Dr. Whitehead: Perhaps the senator is referring to the lack of Commons committees, and in this sense, of course, the Senate committee has been in our view an extremely welcome and valuable step. Speaking for myself, I would certainly like to see more public discussion of this kind, and I think we would regard ourselves as very interested in making suggestions for how the two sides, as you put it, would be fairly represented, because we endeavour to do this in all our activities in science.

Senator Sullivan: Mr. Chairman, I was very interested to hear Dr. Weir say that they had not edited these various reports in this brief, because I am sure there has been an awful slip-up, and I am not attempting to be facetious before such distinguished men as Dr. Weir, Dr. Whitehead and Dr. DesMarais. But on page 12 of your brief, there is a remark under the heading "Psychology", a study that I am not really the least bit interested in, a remark with which I completely disagree:

Although amongst scientists, psychologists have a higher than average educational level . . .

Well, I would not accept that. I presume, if the panel remains silent, the members of the panel feel as I do, then.

The Chairman: Some psychologists would be medical doctors, I presume.

Senator Sullivan: I assume we can attribute that remark to the distinguished pair from York University. They must have put that remark in themselves.

Dr. Weir: I would just comment on this remark, Mr. Chairman, to the effect that this is one of the risks we take in having specialists and study groups do this.

Senator Sullivan: And it is a great risk.

Dr. Weir: You can be sure that this was in the report. It is not our comment.

Senator Sullivan: I am sure.

Senator Grosart: I might just comment on the point made by Senator Thompson. He was referring, of course, to what I regard as a very useful feature of the American Congressional committee system. I have read a good many of their reports, and they do this very thing: They present the evidence; they sum it up, and they weigh the pros against the cons. That is the procedure they adopt for every

single clause of a bill that is before a Congressional sub-committee. We have had something of that here. Yesterday we had the National Research Council open its presentation to us with a rebuttal of certain remarks made by Dr. Solandt. Perhaps we are making progress along that line.

The Chairman: I have just two more specific questions. The first is related to the responsibility of the Secretariat in the field of international relations. Do you have complete control at the official level—of course, in co-operation with the Department of External Affairs—of our international relations in the field of science and technology? For instance, does the National Research Council have representatives outside of the country?

Dr. Weir: Well, Mr. Chairman, our responsibility at present regarding international relations is in an advisory capacity to the Department of External Affairs which has the responsibility for this activity. We have a particular interest in the field of science policy and we recommend to the Department of External Affairs candidates to occupy the posts of Science Counsellor in the embassies. We advise it on questions having a bearing on Government policy on science. We do not have any control as such on this matter.

The Chairman: I see.

Dr. Weir: In addition to the Science Counsellors there are agencies and departments of Government that maintain specialist officers, liaison officers, for their own particular kind of work to send back technical information for their own specialized interests.

The Chairman: Do you have a say about this, whether or not a particular agency should have representation abroad?

Dr. Weir: We have not as yet faced this question. If we did, it would be, I suggest, in an advisory role. It is our intention now to have a look at the whole Canadian picture of scientific representation abroad so that we can see what Canada's effort is now and what changes, if any, we need to make. It is in relatively the same position as the inventory stage, in that we must find out what is really happening and see what is an appropriate change to make.

The Chairman: There would be several agencies, I am sure, that would have some representation abroad.

Dr. Weir: Yes. The National Research Council, the Defence Research Board, and Trade and Commerce are in this field; and I believe Agriculture and National Health and Welfare are also. May I ask Dr. Hughes to comment on this.

Dr. E. O. Hughes, Science Advisor, Science Secretariat of the Privy Council Office: Full-time representation abroad is carried on by the Science Counsellors, who are now on the staff of the Department of External Affairs, and by the National Research Council which has two officers in London.

The Chairman: Only in London? They have no one in Washington?

Dr. Hughes: No. It is also carried on by the Defence Research Board, which has representatives in Washington, London and Paris. I am not sure if they have any representatives elsewhere. Part time representation abroad is really related to the departmental objectives. That is, many of the trade commissioners have a scientific background and there are Defence Production attachés who have a scientific and engineering background. But these are not full-time scientific representatives.

Senator Grosart: How many Science Counsellors do we have in our embassies? Three?

Dr. Hughes: At the present moment we have one in Washington, one in Paris, at the embassy, and one at the OECD mission in Paris. Shortly there will be one in Canada House in London.

Senator Thompson: I believe we have an ambassador who has a scientific background.

Dr. Hughes: I am not aware of that.

Senator Hays: Mr. Chairman, how does this function? If I may make a point, I was in Uganda in October, and I had lunch with the Vice-President. He was very concerned about the need for scientists. They needed scientists and people to help them in the boat-building business and that sort of thing, but they were having great difficulty receiving this sort of technical help from any country. They were quite concerned about it. How would they approach that problem? What would be their approach to get this sort of help from Canada, for example?

Dr. Hughes: It is my understanding that they approach Canada through the External

Aid Office now known as CIDA, and that they do go to various countries to get expert advice.

Senator Hays: Well, they were not having much luck with it then.

The Chairman: In any case you are giving another look at this whole field. Now my other question is related to your brief on page 3 where, in describing your responsibilities, you say "By means of some of its in-house studies the Secretariat attempted to make an inventory of the scientific work being done in Canada, to gauge our scientific manpower position, and in general to understand, forecast and advise on the impact of science and technology on the future of our society." What kind of work have you done up to now which would be directly related to this last residual clause of your functions and responsibilities? It seems to be very broad here.

Dr. Weir: Yes, Mr. Chairman, and it was from our very early consideration of this need that I responded to the question of Senator Grosart on science policy. In order to even attempt to meet this change we feel we must develop a backdrop of what a science policy is to see how these various components fit this picture. So I think I would have to say to you that we have done some staff thinking on this and we have some very, very early thoughts put down on paper. We have been attempting to discuss it. I think we are not really in a position to give you any thoughtful comments on it at the present time, and my only answer to you is that this is one of our major exercises now to try to see what this really means.

The Chairman: Are you interested in looking at the possibilities offered by some apparently old techniques, as we were told yesterday, with regard to technological forecasting? I have in mind the kind of work that is being done by private institutes in the United States, at Harvard and Stanford—that kind of work which is now being carried on more and more in Europe, we understand, in Germany, France and Great Britain.

Dr. Weir: Yes, we are and it is in this connection we find our association with other international activities of OECD and some of their bodies of great value. This obviously has to be tied in to the tools by which this can be done, as Dr. Whitehead was commenting on, for instance, the information the data banks are processing. We are trying to frame out, if we can, more broadly all the aspects of

this and to look at some of the modern tools that may assist us on this.

The Chairman: It is just a beginning.

Dr. Weir: Yes.

Senator Thompson: Do you place some considerable credibility to these tools? Yesterday we had one gentleman tell us he relied more on common sense.

The Chairman: In order to brief you on this, and to let you know more specifically what is meant, this is what was told to us yesterday by Dr. Cook, the *délégué général* from the National Research Council.

Dr. Weir: My answer is, and some of my colleagues may wish to amplify this, that I myself believe that common sense is the final decision-making apparatus.

The Chairman: Even when you attempt to forecast technological change and its impact on society?

Dr. Weir: I think the comment the chairman has just made and the rapid increase of information in this field are what make it necessary to have this information gathered and presented in a form in which common sense can be applied to a more informed background than without it. This is how I myself place these things. I am sure Dr. Whitehead has given a great deal of thought to this. He was very interested in the tools and the background of this as well as the implementation of the advice.

Senator Grosart: Dr. Whitehead, I think this applies to what has been spoken of at times as "uncommon common sense." Do you have within the Secretariat any mechanism or concepts for the setting of priorities in a national science policy?

Dr. Weir: Senator Grosart, this is of course one of the things which you meet with when you begin to think of the development of science policy. Again we have had to give some thought to this. Maybe it would be more expedient if Dr. Whitehead could include this in his reply. I am glad you raised this question because it is one thing that is very vital.

Dr. Whitehead: First on technological forecasting and the modern tools. I tend to agree with Dr. Weir's implication that perhaps these are sometimes over-formalized. On the other hand there is an enormous amount of

useful content and we are aware of what is going on. I would like to emphasize what Dr. Weir said about the extraordinary value of our international contacts in this and other resources.

The Chairman: In the United States there is a growing industry which deals only with technological forecasting and there they devote many millions of dollars per year to this, so there must be something to it. Otherwise somebody doesn't have the common sense we think they have.

Dr. Whitehead: The OECD has sponsored a book by Jantsch which is possibly one of the best books on the subject. Now regarding priorities and answering the question on what are the areas of science that are important—which is almost a meaningless question—and how do you determine priorities and how do you allocate resources? I feel that this is a vastly more complicated question than is normally realized. One comes across a great many generalizations on this which really if they are analysed are found to be quite meaningless. For example, one hears that "Transportation is important" and I would go so far as to say that transportation is essential.

Senator Grosart: Such as the Science Council report No. 1.

The Chairman: No. 4.

Senator Grosart: No. 4.

Dr. Whitehead: There is a very wide range of areas of simultaneous national importance. Perhaps it would not take too much time just to list a few of them and to give an idea of the complexity involved.

The Chairman: Senator Grosart went so far yesterday as saying that sex was also an important research program.

Senator Grosart: I said in Japan it is.

Dr. Whitehead: I hasten to say it was not in my list, sir!

They include: non-renewable resources, such as minerals and fuels, the mining, petroleum, steel, aluminum and other primary industries—the relation of science and technology to these; renewable resources, such as agriculture, fisheries, forestry, including the food, pulp and paper industries and large sections of the chemical industry; human resources, such as educational technology and fundamental research—whether

you look upon it as a scientific, cultural or educational activity, or a combination of these; health and welfare, such as medical and pharmaceutical research and technology; cultural technology, such as radio, TV; transportation, including road, rail, sea and air systems and vehicles, particularly systems; the scientific aspects of accident and injury-prevention, which come well within these definitions; communications technology and computerized information systems and data banks—satellite communications form just a small part of the communications category, yet a very large thing these days; the environment, such as urbanization problems, building research, even domestic appliances, pollution. I am deliberately being a little random. They also include the physical environment: meteorology, oceanography, geology, astronomy. You could readily extend the list to include thousands of items.

The Chairman: These are the problems, not the projects?

Dr. Whitehead: Yes, these are the problems. This is to illustrate the extreme complexity of the problem of priorities.

The criteria for the allocation of the resources to any one project, or to any one sub-project within any one of them, require the consideration, at that level, of scientific, social, economic, cultural and political factors. These are not necessarily the same even for one part of this as for the other.

This is really the crux of the problem of the determination of priorities. The degree of priority for the allocation of Government resources accorded to one project in transportation may need to be completely different from that accorded another.

Senator Thompson: I think I differ from my colleagues. I rather respected the Science Council for setting a list of priorities. I think somebody has to do this, and then see what the attitude of the people is across the country to them.

For example, I feel that if this had been done in the United States, if they had asked themselves whether they should go into moon exploration, and so on, and the scientists had listed these different priorities, my own feeling is that they might have gone in for urban renewal or medical insurance rather than moon exploration. I think their problem was, and our problem is, that the public do not have a choice of priorities, and this has concerned me greatly.

I do not know if you think it, but I would hope that, if you do not, the Science Council will continue to present what they see as the priorities; and then it becomes a political decision.

Dr. Whitehead: I agree with Senator Thompson on the value of presenting priorities, at whatever level of breakdown. I am rather horrified to feel that he interpreted some of my remarks as indicating criticism of the Science Council's report, which I had no intention of doing.

Senator Thompson: I was not referring to you.

The Chairman: There was the implication.

Senator Thompson: There were other of my colleagues.

Senator Grosart: That was my inference—just to exonerate Senator Thompson.

Dr. Whitehead: Clearly, the answers are going to be quite different for, say, hovercraft and spacecraft, for nuclear power and thermal power. If the universities or industry have a significant part to play—and in many cases they have the whole part to play—will it occur naturally or does it require Government action in the form of grants or incentives? Therefore, the priority for the allocation of resources might in this sense be quite different from the priority of the particular subject or project under study, because the priority for intervention of the Government itself can be different from one project to another.

Perhaps I could reiterate that as a consequence of this complexity the background to decision can, in our view, only be provided by using modern techniques for the storage, presentation and processing of information, because the base from which you are working in this is, as Senator Grosart explained, the information of what has been done, of what exists, because it is essential, of course, to go from where we are and not try to create a hypothetical circumstance which has no continuity with the present.

Science policy decisions are, of course, made at many different levels of Government, and it is conceivable that one could even look back at the logic of the decisions that have been made at another level in considering the recommendations at the high level in the course of discussing the policy decision at the

high level. This is not by any means inconceivable with computer techniques.

Senator Grosart: Is that not exactly what we have done in trying to restore the balance, by up-grading the industrial aspect of our research? I understand from your report, or the report that you quote, that in looking over the whole aspect of Canadian research it was found insufficient in industrial laboratories. I think we have a lot of crash programmes, such as the Industrial Research and Development Incentives Act (IRDIA) and the Program for the Advancement of Industrial Technology (PAIT). This is exactly the thing you are talking about, but it does not seem to be any assessment of overall priorities. Everybody says we are low in industrial research, and everybody gets into it—such as the Department of Industry with its incentives; but there is no evidence, I can see, of any conscious planning of national science policy in respect to priorities.

Dr. Whitehead: Yes. If I might mention, Mr. Chairman, I think this matter of discretion and the techniques for discretion are vitally important. It is the information content that is lacking to do it, but also there is perhaps lacking a linkage between the expenditures in Government which on the same subject go to industry, to universities and within Government. Often these decisions are made by totally independent bodies, and I think one of the very important things in the future is to obtain a mechanism by which the policy for the conduct of research can be linked in these three sectors, and I think there are a number of quite practical mechanisms for achieving that.

Senator Thompson: I am speaking generally. Could you give what you see as the factors—say, the three major factors in order that a certain study should be given priority, if you were making a list of priorities?

Dr. Whitehead: I think, Mr. Chairman, it is practically almost an impossible question to answer, because I think they vary in importance with the nature of the project.

Senator Thompson: I should say that the Science Council did suggest three or four factors.

The Chairman: And some departments are more and more trying to do it now. I think the Department of Energy, Mines and Resources has been.

Senator Hays: How are you going to have priorities if you do not do it? Somebody has to determine these priorities. Somebody has to go out on a limb, right or wrong, and say, "This is important, and this is what we are going to do."

Senator Grosart: And to do it you must have criteria.

The Chairman: I suppose we do have priorities by accident.

Dr. Weir: I might just comment, Mr. Chairman, that the fact that we have looked at priorities—this has been mentioned a number of times—and are establishing lots of projects, has tended to over-simplify the situation in the minds of many people. We need to identify the various complex components, if we are going to move ahead in approaching this in a meaningful way.

Senator Grosart: Mr. Chairman, is it not so that there are now dozens of studies—and I have seen several—attempting to set up criteria in the selection of priorities in a national science program. Are they helpful?

Dr. Whitehead: Yes, I think, Mr. Chairman, that they summarize the matter. I mentioned earlier the scientific, economic, social, and cultural priorities—and the political priorities, of course; I imagine they all come within those—but the various criteria have quite a different significance in the context of different programs. For instance, in one, national security, or national integrity, or national identity within the political criterion might be important, and in others they might have no significance at all.

Senator Grosart: National pride?

Dr. Whitehead: Prestige. Certainly in some I think the main criterion within science and technology is, of course, that it should be good. That is a scientific criterion itself. But, the aim of science policy—and this is only a part of it—is the optimum use of all the resources, whether they be scientific, economic, or cultural. My thesis really was that it is extraordinarily easy to over-simplify this question of the application of criteria, and to come out with simple rules of thought. If I have been reluctant to give any quick answers myself I will say it is because I really do not think there are any.

Dr. Weir: Might I say, Mr. Chairman...

The Chairman: In other words, there is not scientific approach to scientific policy?

Dr. Whitehead: I did not say that, sir.

Dr. Weir: I want to comment on what we see as the interesting thing that is unfolding in the field, and that is that the literature in the subject is influencing the thinking behind evolving science policy, and I think it is going to contribute to a more rational approach. As Dr. Whitehead said before, we certainly feel that this Senate committee is contributing very greatly in fostering this thinking, and to this background of knowledge. So, this is really a development of the literature.

The Chairman: Before we come back to Senator Hays' question, I should like to ask another very quick one. Do you cover the social sciences in your inquiries, and in your worries?

Dr. Weir: Well, Mr. Chairman, I think I can say that we have not covered the social sciences in our activities to date. They are certainly in our problems. We meet the interface between these continually in the work we are doing. I think the fact that we have listed these as some of the criteria for developing priorities, and the development of a science policy, is an illustration that we meet them. We are not at present in this field.

The Chairman: There is nothing to prevent your doing it, though?

Dr. Weir: Well, this will...

The Chairman: You do not have the same limitation that the Science Council has.

Dr. Weir: No. We, of course, would be faced with the problem of staffing and getting the people who would bring an expertise in this field. I am sure you are well aware of the study on federally-supported research in the universities being made by Dr. Macdonald's group, which is reporting to the Science Council.

The Chairman: But that is only within the universities.

Dr. Weir: Yes.

Senator Grosart: Mr. Chairman, may I put one brief quotation in the record? I think it is relevant. It is from an article entitled "Operational Research Methods in the Management of Scientific Research", and is as follows:

Increasing attention has been paid lately to the study of scientific creativity.

Science has become the subject of special studies. This is justified, on the one hand, by the increasing necessity of understanding the mechanism of scientific activity in order to direct it and, on the other, by the realization that such a study is becoming possible. A complex "science of science" is in process of development.

It so happens that this was written by George A. Lakhtin, a very distinguished Russian. From some of the literature and bibliography I have looked at—I have not read it all—it seems that the Russians are doing more in this field than anybody else.

Dr. Whitehead: Could I comment, Mr. Chairman?

The Chairman: Yes.

Dr. Whitehead: I participated, the year before last, in an international "science of science" symposium in the U.K. on the subject of decision-making in national science policy, at which representatives from many countries, including G.M. Dobrov from the U.S.S.R. were present, and at which most countries expressed their own approach to the scientific analysis of science. Perhaps I might pick up from Senator Thompson's final question, "Where does that leave us?" which I think I heard, senator.

Senator Thompson: Yes, you did.

Dr. Whitehead: I think it leaves us with the message that the storage and presentation of information, and the use of modern techniques in the widest possible sense of presenting not only information but argument—a basis for logical decision—to all levels of government, right to the highest level, is perhaps our greatest priority at the moment.

Senator Grosart: That is very good.

Senator Thompson: Could I come to your question with respect to the social scientists. I am a layman in this area, but I have the impression...

The Chairman: Here we have a former practising politician who does not know anything about the social sciences.

Senator Thompson: That is right, but I have felt that the social scientists get only lip service from the scientific community. They appreciate that many of the problems that they are asked to tackle have great implications in the social area, and they run all the

way from urbanization to water pollution, and so on, and there is a sort of passing reference to the fact that they will use the social scientists. I would ask you two questions. Is it because you cannot get spokesmen from them, is it because you do not think that social science had developed yet into a science that you are not marrying yourself with these people?

Dr. Weir: Mr. Chairman...

The Chairman: You had better be very careful in your answer, because we are receiving this afternoon the Governor of the Bank of Canada.

Dr. Weir: I heed the warning of the Chairman in replying to your question, senator. I am not qualified to speak of the social science field. It has been my general impression that it has been somewhat later developing than the natural science field. If this impression is true then I would hope it will soon catch up because I think it has a tremendous part to play as a major component in all of the things we have been talking about. As I said previously, we come to the social science problems before we go very far in our thinking on science policy.

The Chairman: Yet at the moment it seems to me that within the whole federal structure there is really nobody who is giving a serious look at the kind of contribution the social sciences could make. There is nothing I know of yet. The Canada Council, of course, has a very limited responsibility in the sense that they are there to make assistance and grants available to universities and to the private community, but within the federal Government there is nobody at present who would seem to be really interested in either reviewing the contribution the social sciences can make or improving it.

Dr. Whitehead: I think perhaps we are short of the sort of people, of whom there are limited numbers in other countries, who have both scientific or engineering and social science qualifications. I think there is a problem of communication between the two groups. Perhaps some physical scientists who are used to being meticulous about putting the boundary values in their equations before they attempt to solve them are ill at ease in an environment where they feel it is not always regarded as necessary.

The Chairman: But then one arrives at the kind of situation where physical and life sci-

entists define social and economic problems for us.

Dr. Whitehead: Yes. This is why it is important to have people trained in both sciences.

The Chairman: Or at least provide communication between the two groups, if we cannot find integration in the individuals.

Senator Hays: On page 26 we have what I suppose are your expenditures, your budget. I notice that in 1967-68 you used something over \$1 million, and in 1968-69 just half that amount. I think this committee would be interested to know whether you have sufficient funds to carry on the work with which you are charged. Perhaps you could comment on your budget. On scientific and technical information; in 1967-68 you used some \$105,000, but in 1968-69 that is cut down to \$62,500. I was wondering if you were trying to do away with this.

Dr. Weir: I wonder, Senator Hays, if you noted that the 1968-69 column is starred and is to August 31, 1968.

Senator Hays: No, I had not noticed that. Probably that answers it.

The Chairman: To go on with that, it seems to me that with the responsibilities you already have, which will inevitably grow if we are to reach a better situation in the formulation of science policy, you really do not have much staff, and the people you now have in their different fields, in their roles of scientific advisors must sometimes feel very lonely.

Dr. Weir: This is true.

The Chairman: We will try to make a plea directly to the Treasury Board when we meet them.

Dr. Weir: Thank you, Mr. Chairman. We certainly appreciate that and will need your support. However, I would say that we are aware of the smallness of our staff at the present time. We are aware of the inadequacy—I think that is the right word—of the staff to cover the very great number of fields. We hope that we can still continue to employ the technique of bringing in people when specialists are needed, so that we have those best qualified to give us the information and make the necessary studies. Under Dr. DesMarais' supervision we have just completed a report on radiation biology, conducted within

the Government. This was a requested study on the subject. We had a study group of four people, one of whom was a specialist in the field from another country. Where we can use this technique, where we can bring in private specialists, we have to proceed one step further and try to interpret the recommendations in the light of this whole policy from a generalist point of view. We should continue to keep our staff in the Secretariat more as generalists, with I hope a variety of academic backgrounds and experiences through the major scientific sectors. Of necessity we have to operate as generalists within the Secretariat.

The Chairman: You do not have enough generalists?

Dr. Weir: That is right. I agree, because of the things that appear to be forthcoming, with the demands and need to have more information, it just will not be possible unless we have the staff support to do it.

Senator Thompson: And I suppose also the tools to get the information. When one thinks of the enormous amount of information coming out almost in a surge, it seems to me that even in the description of a computer you just will not keep up to date if you do not get such tools.

Senator Hays: I thought Dr. Whitehead made a very important point when he said that the number one priority was information. We have only to think of even the information we have received in the last two days. Yesterday, for instance, we heard that 15 years passed by before projects that had been pigeon-holed came out and became used, although industrialists could have used them 15 years earlier. It seems to me the budget for information is entirely inadequate.

The Chairman: When will this study on information be published?

Dr. Whitehead: It is a Science Council study and is in the hands of the Science Council. I understand publication of Part I of the report is imminent. I am not sure of the details. Perhaps the Executive Director of the Science Council, who I think is present, could give the answer.

The Chairman: If you can.

Dr. P. D. McTaggart-Cowan, Executive Director, Science Council of Canada: Volume I is just about ready to go for publication,

but there is one section of Part II, which is the background material, which did not meet the tests of the referees, and that is being rewritten. We have to wait until that rewrite has gone sufficiently far that the main working group is sure they will not change any of their recommendations in Part I. As soon as I get that assurance, the only delay then will be the length of time to run it through the presses. There is this rewrite, which is in a critical section. It is the question of university life.

Senator Grosart: I hope it includes a chapter on the ten years Odyssey of frustration of Mr. Newcombe.

Dr. McTaggart-Cowan: It could do.

The Chairman: On behalf of the committee, thank you very much indeed, Dr. Weir, Dr. Whitehead and Dr. DesMarais. It was a very interesting morning.

The committee adjourned.

APPENDIX 23

RESTRICTED

SCIENCE SECRETARIAT
PRIVY COUNCIL OFFICE

SUBMISSION
TO
THE SENATE OF CANADA
SPECIAL COMMITTEE ON SCIENCE POLICY

December 19, 1968.

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RESTRICTED

BRIEF TO THE
SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA

Prepared by
The Science Secretariat, Privy Council Office

Introduction

1. The establishment of the Science Secretariat was first recommended by the Royal Commission on Government Organization. This recommendation was endorsed by Dr. C. J. Mackenzie in a report to the Prime Minister on government science. The establishment of the Science Secretariat in the Privy Council Office was formally announced by the Prime Minister in a statement to the House of Commons on 30 April 1964. In this statement he outlined the functions of the Science Secretariat as follows:
2. "... that a Scientific Secretariat be established to assemble and analyse information about the government's scientific programmes and their inter-relation with other scientific activities throughout Canada."
3. The Science Council of Canada was established through the medium of The Science Council of Canada Act which received Royal Assent on 12 May 1966. The Act did not provide authority for the Science Council to hire staff on its own. Therefore, the Science Secretariat was directed to provide all staff services for the Council.
4. Thus the Science Secretariat has performed a dual role since the establishment of the Science Council in 1966. This arrangement did justice neither to the Science Council nor the Science Secretariat, since neither organization had the measure of freedom to discharge its responsibilities properly.

5. In order to give the Science Council more freedom and flexibility and in order to permit the Science Secretariat to concentrate more fully on its duties within the Government, the Science Secretariat no longer has any responsibilities to the Science Council. To form a nucleus of staff for its future work, the Science Council has retained somewhat more than half of the total Science Secretariat staff to work exclusively for the Council.

II. 6. Function and Organization

In discharging its advisory function the Science Secretariat is required to gather information from many sources. Some of this information, by its very nature, is confidential. Some, is obtained, nationally, through its contacts with other government departments and agencies and through appropriate associations with universities and industry. Internationally, this is accomplished either through the Department of External Affairs or directly from scientific agencies in other countries

7. The activities of the Science Secretariat are now concentrated in two main areas which are basically dependent on access to wide sources of information. The first of these is related to its responsibilities in the Privy Council Office. Since the Secretariat is the scientific arm of the Privy Council Office, it participates in all its activities insofar as scientific matters are involved. Accordingly, it may be asked from time to time to respond to requests from the Prime Minister, Cabinet Committees, the Cabinet Secretariat and Treasury Board. It also serves as the centre for organizational development of inter-disciplinary science-based activities and supervises the planning for appropriate research organizations.

8. The second of these is its responsibility in the field of international science policy. In this capacity it advises the Government on scientific issues in international relations, and in particular, coordinates, in cooperation with the Department of External Affairs, communications with other countries on matters of science policy. The Secretariat represents Canada on the OECD Science Policy Committee and similar bodies. It advises the Department of External Affairs on policy regarding visits and exchanges of scientists with other countries. The Secretariat is responsible for recommending the appointment, relocation and policy for scientific attachés abroad in cooperation with the Department of External Affairs.

9. The Science Secretariat found that the activity of serving the Science Council in the interval 1966-68 took up the major portion of its resources in terms of manpower and budget. This function not only involved the provision of administrative, stenographic and publication services, but also encompassed responsibility for background studies for the Science Council. In addition the Science Secretariat performed in-house studies which served its dual responsibilities to the Privy Council Office and the Science Council. By means of some of its in-house studies the Secretariat attempted to make an inventory of the scientific work being done in Canada, to gauge our scientific manpower position, and in general to understand, forecast and advise on the impact of science and technology on the future of our society.

10. It should be emphasized that separation of the Science Secretariat and Science Council does not imply a break in communications. Strong ties are expected to remain and, indeed, from time to time the Secretariat is expected to request that studies be undertaken by the Science Council that are more appropriate to its role.

11. Organizationaly, the Science Secretariat staff consists of eleven professionals including a Director, two Principal Science Advisers, four Science Advisers in different groups of disciplines and areas of application and four others. The four will include a Supervisor and Coordinator of staff functions and operations, three engaged in data, statistics and economic analysis and on the routine activities related to the Secretariat's international responsibilities. The total establishment includes a number of secretaries and typists, but administration is the direct responsibility of the Director of Administration of the Privy Council Office and no additional staff is required for general administration. A chart of this organization is attached (Chart No. 1).

II.A. Activities Within the Privy Council Office

12. The relationships of the Science Secretariat within the Privy Council Office are shown, schematically, in Chart No. 2. One function of the Science Secretariat with regard to the Privy Council Office is to act as a source of information, on a day to day basis, on scientific matters for the Prime Minister, the Cabinet, and Cabinet Committees in the Cabinet Secretariat. The major Cabinet Committee concerned with science is the Privy Council Committee on Scientific and Industrial Research. Members of this statutory committee are the Ministers with major responsibilities for science and technology, the Secretary of State for External Affairs and the Minister of Finance. The Privy Council Committee is advised by the Advisory Panel on Scientific Policy consisting of the deputy heads of the science-based departments of the government, the Deputy Minister of Finance, the Secretary of the Treasury Board, and the

Special Committee

Under-Secretary of State for External Affairs. The panel is chaired by the Secretary to the Cabinet and its Vice-Chairman is the Director of the Science Secretariat.

13. These committees have performed a very useful function but have not displayed a particularly aggressive stance with respect to science and science policy. The separation of the Science Secretariat and Science Council coupled with the recent release of the Science Council's Report No. 4 entitled "Towards a National Science Policy for Canada" may serve as a spur to more frequent meetings of these committees. While the Science Secretariat has provided staff support to the committees, this task has been shared with the Cabinet Secretariat. It is anticipated that in the future the Science Secretariat will provide the required staff and that these committees will become an important part of the policy-making machinery on science.
14. Secondly, as a part of its functions within the Privy Council Office, the Secretariat attempts to identify scientific and technological issues that are important in national policy, and to provide a dimension of scientific judgement to the Treasury Board and Cabinet Committees. The Secretariat is particularly well placed for this activity, since it has no operating or granting responsibilities. It can consequently take a more neutral and dispassionate view of science matters affecting departments and agencies of the Government.
15. The final area of responsibility within the Privy Council Office is that related to the planning functions of the Privy Council Office primarily dealing with scientific and technological matters. Two examples of the latter responsibility may be found in the Task Force on Satellite Communications and the

Study Group on Astronomy. The Government directed the Science Secretariat to form a Task Force to consider the factors involved in the establishment of a satellite communications system for domestic purposes. In this study the Task Force not only considered the scientific and technological aspects but also took account of the social, economic, legislative and institutional facets of this question. For example, they considered the potential of a communications satellite for the establishment of a nation-wide television service in both French and English and a telephone service to remote areas, including the north, which cannot be economically served by conventional systems. All relevant bodies both inside and outside the Government were consulted in the course of the study. The results of this study were presented to the Government. Later a White Paper on a Domestic Satellite Communication System for Canada was issued by the Minister of Industry.

16. The Study Group on Astronomy was established by the Science Secretariat at the request of the Government to assess the relative scientific merits of various proposals for the construction of major observatories at Mount Kobau and in Chile. The Group reported in August, 1968 after holding intensive hearings with all interested groups. The report is still under consideration.

II.B. Responsibilities in the Field of International Science and Technology

17. In this field, the Secretariat advises the Department of External Affairs on non-departmental and inter-departmental aspects of science and technology which affect our foreign policy, provides departments and agencies of Government with information on science policy developments abroad, and is a focus for infor-

mation on domestic scientific activities for the Department of External Affairs and foreign embassies in Ottawa.

18. The existence of the Science Secretariat as a non-departmental focus led the Government, in 1967, to assign to it the responsibility for advising the Department of External Affairs on the selection of Scientific Counsellors for Canadian posts abroad, and for providing guidance and instruction in their work. At the present time, Scientific Counsellors are on the staff of our Embassies in Washington and Paris, the High Commissioner's Office in London, and the Permanent Delegation of Canada to the Organization for Economic Cooperation and Development (OECD) in Paris. In brief, these officers advise the heads of posts on matters of science and technology affecting foreign policy and report on scientific developments of interest or concern to departments and agencies of the Government of Canada. The Science Secretariat ensures appropriate distribution of these reports.
19. In 1966, the OECD established a Committee for Science Policy on which the national science policy organizations of all member countries are represented. Members of the Science Secretariat have attended all meetings of this Committee, accompanied by representatives of other organizations when the subject matter warranted (e.g., the Science Council, National Research Council and Department of Industry). Because of its membership on the Committee for Science Policy, the Science Secretariat has been responsible, in 1968, for Canadian participation in the Ministerial Meeting on Science and for arrangements for the OECD review of Canadian Science Policy. The Secretariat has also provided assistance to the OECD expert groups on the economics of scientific and technical information and on international statistical comparisons of research and development.

II.C. Activities Related to the Science Council of Canada

20. The purpose of this section is merely to explain as background, the former activities of the Science Secretariat in relation to the Science Council. All inventory studies initiated by the Science Secretariat but not completed at separation are now the responsibility of the Science Council.
21. The Science Council of Canada was established in 1966. The purpose of the Council was outlined in the Council's First Annual Report as follows:
- "....The purpose of the Science Council is to try to ensure that Canada has a strong and competent alert and growing scientific community and to advise the Government on how best to use science in the solution of the economic and social problems of Canada The Science Council will seek to identify and define major problems, to recommend the broad allocation of manpower and money among competing needs and to ensure that appropriate organizational and institutional arrangements are made for the most effective use of these resources ... "
22. The Science Council is not an agent of the Government and had no support staff of its own. Thus the Science Secretariat provided the secretariat and other supporting services to the Science Council. In terms of budget and manpower the largest effort in this respect was devoted to background studies for the Science Council.
23. Once the decision had been taken to initiate a study, the following sequence of events generally took place. The Secretariat, in consultation with the Science Council, formed a study group and terms of reference were drawn up. The Science Council established a committee on the same subject matter.

The study group's report on its findings was published as a Science Secretariat Special Study. This background study was considered first by the committee and then by the entire Council. The final step was the publication of a Science Council Report containing policy recommendations.

24. As a matter of policy, in each study a serious attempt was made to involve the scientific community of Canada to the greatest extent possible. Consequently, most studies have been commissioned to outside consultants. In some cases this was done by means of contracts with appropriate professional organizations, whereas in others the most suitable individuals were engaged directly by the Secretariat. In all cases the Secretariat attempted to obtain the services of the best qualified people in the country. Project officers from within the Science Secretariat provided the liaison between the study group and the Secretariat and Science Council. In several cases project officers were seconded from other federal departments to the Science Secretariat. Federal and provincial Government departments, the universities and industry have been extremely cooperative.

25. In the following sections a brief description is given of the studies that have been undertaken by the Science Secretariat during its period of existence up to separation. Most of these studies have served as background material to the Science Council, although some were initiated and completed by the Science Secretariat without specific Council requests to do so.

Studies may be divided roughly into three categories.

26. The first of these categories is related to more or less distinct single disciplines such as

physics, chemistry, basic biology, etc. The discipline studies were, in the majority of cases, originated by the Science Secretariat. The purpose of the discipline studies was to a large extent the making of an inventory of the state of science in Canada. Previous to the establishment of the Science Secretariat no reliable data were available on expenditures in specific fields, the involvement of different sectors of the economy in scientific activities, the strong and weak points of Canadian science, and the scientific manpower available and anticipated in different fields. It was, of course, difficult to make policy recommendations in the absence of these kinds of data.

27. The second category of studies encompasses fields of use or application rather than disciplines, e.g., agricultural research, scientific and technical information. The studies in this category resulted usually in a background report for the Science Council containing recommendations for policy in the particular field of application or use.
28. The third category includes a miscellaneous group of studies. Some of these, such as the study on support of research in the universities, were related to a sector of the economy of importance to science in Canada, whereas other studies have been in response to a specific request for an opinion on the feasibility or desirability of a specific large project. The Intense Neutron Generator (ING) study was an example of the latter.

29. Five studies by discipline were initiated by the Science Secretariat and are now the responsibility of the Science Council. Two studies have been completed, one is near completion, and two are under way.

Physics

30. The results of this study were published in Special Study No. 2, "Physics in Canada, Survey and Outlook". The study was carried out by the Canadian Association of Physicists under contract to the Secretariat. The Association appointed Dr. D. C. Rose, former Associate Director, Division of Pure Physics, National Research Council, as Chairman of a Steering Committee. The Steering Committee appointed twelve sub-committee chairmen to study in detail twelve subdivisions of the field of physics.

The principal findings and recommendations were summarized in the report as follows:

31. "... This report surveys the present state of research in physics in Canada. It finds the present effort heavily concentrated in the pure aspects, and relatively weak in the applied aspects of physics. It finds the support reasonable in the Government laboratories, poorer in the universities, and insufficient in the industrial research laboratories.
32. "It recommends that over the next few years, support should emphasize those aspects of Canadian research in physics that can encourage the wise use of our national resources or can benefit from our particular geographic location or scientific history.

33. "It finds that the present overall growth rate is a great improvement over the level in the past and suggests that the normal expenditure on physics research should rise at a rate of 23 per cent per annum.
34. "It recommends that several joint institutes be created where scientists from many laboratories of the universities, the Government and industry can jointly make use of outstanding facilities that would be too expensive for individual laboratories to maintain and use effectively."
35. The Science Council has established a committee on the Physical Sciences which will use the material contained in Special Study No. 2 as background material.

Psychology

36. The study of Psychology in Canada was published in a report of the same title as Special Study No. 3. The study was carried out, under contract, by the appropriate professional society, the Canadian Psychological Association, which charged Drs. M. H. Appley and Jean Rickwood of York University with the task.
37. The report pointed out that in Canada the number of psychologists in relation to population is low in comparison with U.S. ratios. Despite the expected increase in available graduates, it is estimated that the need for psychological services personnel is likely to outstrip supply for some years to come. Although amongst scientists, psychologists have a higher than average educational level, the level is low compared to the U.S. Immigrants, primarily from the U.S., comprise one-fifth of Canada's community of psychologists.

Most of these are doctoral level people. Of the doctoral group less than half were professionally trained in Canada. Although Government grants to psychologists have increased over 350 percent in the last five years, and support from all sources has increased five-fold during the same period, the support per psychologist is considerably below the level of support in the U.S. Research funds should increase over 300 percent from 1966 to 1970 and double again by 1975 to meet forecast demands. Probably five-sixths of the total funds needed will be requested from Canadian Government sources.

38. The report cited the following problems for psychology in Canada:
1. the need to improve the ratio of psychologists to population;
 2. the need to keep Canadian students in Canadian universities for their graduate training and to attract immigrant students to quality programs in Canada as a means of recruitment into the work force;
 3. the desirability of improving the educational level of those providing psychological services and of improving the research position of these psychologists;
 4. the continuing need for recruitment of doctoral personnel from other countries, especially the U.S.;
 5. the consequent need to compete with U.S. academic institutions in terms of improved research financing, reduced teaching loads, and other factors;

6. the continuing need for more psychologists than are available (about 15 percent work on an overtime basis in addition to their principal employment);
7. the manpower costs implied in a possible under-use of service capacities and a heavy commitment to necessary administrative duties;
8. the importance of maintaining the unique role of Government in support of basic research;
9. the need for increased and continuing support and facilities for a greatly expanding body of academic psychologists and psychology students if any of the other needs are to be met.

Chemistry

39. The survey of Chemistry was initiated at the end of 1966. The study consists of a comprehensive survey of chemistry research and development in Canada, in universities, government and industry; the extent to which it is supported by private and public funds and the location and subject matter of all significant work. It will assess the relative scientific, economic, and social importance of the major activities in chemistry research and the balance between them, with particular reference to locating serious gaps in the pattern. The future of chemistry research will be considered and recommendations made on what objectives should be set for the next five years' program.

40. The study was performed by the Chemical Institute of Canada with Dr. A. E. R. Westman, former Director of the Ontario Research Foundation, as chairman of the study group. A draft final report has been prepared as of 1 January 1969. The report will be submitted to the Science Council, which has formed a committee on the Physical Sciences. This committee will consider the report in conjunction with the one on Physics.

Basic Biology

41. This study was proposed as a necessary part of the first review of scientific research in Canada. It is complementary to studies in applied fields, such as in medical research and agricultural research, important to the welfare or economy of Canadians and Canada.
42. The study was first proposed at the third meeting of the Science Council, on November 28/29, 1966, and was approved at the seventh meeting of June 19, 1967. The Science Council has formed a committee to receive the report.
43. The contracting parties, the Biological Council of Canada and the Canadian Federation of Biological Societies, are charged with describing and assessing basic biological research in Canada, including applied research which contributes to the understanding of the basic phenomena and concepts of biology, outlining areas of neglect and limitations, and presenting qualified opinions on future trends and needs.

44. The Study Director, Dr. K. C. Fisher, of the University of Toronto, and his committees are now examining data obtained in the spring of 1968, by questionnaire, and hope to report early in 1969.

Earth Sciences

45. This study was started in September 1968 and is scheduled for completion in late 1969.

Specific aims of the study are:

- (a) to survey the organizational framework for scientific activities in the Earth Sciences in Canada;
- (b) to survey the scientific activities now carried out in Canada, including those performed by universities, government, industry and non-profit research organizations; including a review and evaluation of the relative magnitude and distribution of basic and applied research, development, data collection, and other categories of scientific activity;
- (c) to study the expenditures in scientific activities, their distribution and their effectiveness;
- (d) to study the characteristics of Earth Science manpower in Canada, using available information from the Department of Manpower and Immigration and other sources;
- (e) to enquire into present trends in the training of Earth Science manpower and to examine factors affecting the future supply of scientists;

Special Committee

- (f) to review the means and effectiveness of information exchange in the Earth Sciences (publications, meetings, seminars, refresher courses, professional societies, etc.);
- (g) to define and interpret the degree of dependence of Canadian scientists on the results of foreign research;
- (h) to recommend major objectives in terms of the various Earth Science disciplines and the various geographic regions of Canada, indicating their relative importance and means of implementation;
- (i) to recommend methods of applying Canadian Earth Science research activities to benefit developing countries.

46. The study is being conducted by a study group under the chairmanship of Professor R. A. Blais of the Ecole Polytechnique, Montreal. The Science Council has established a committee on Earth Sciences to consider the report of the study group and to draft the final policy recommendations.

47. The second category of studies were those broadly related to a general area of application or use. Studies in this category included those of research on the upper atmosphere and space, water resources, agriculture, transportation and aeronautics. Priorities were in some cases determined by public interest or by the realization that vital policy decisions might have to be made within a relatively short period of time, whereas in other cases the Science Council judged an area of application to be of great significance to the future of the country.

Upper Atmosphere and Space Programs

48. This study was conducted by a study group consisting of four scientists headed by Dr. J. H. Chapman, of the Defence Research Board. The results were published in Science Secretariat Special Study No. 1 entitled "Upper Atmosphere and Space Programs in Canada".
49. The purpose of the study was:
to review existing Canadian financed research and development related to space and the upper atmosphere and to assess the significance of the various projects in respect to their contributions to scientific knowledge, education and technological training, and to the country's economic interests, both immediate and long-term, and to study the aims and objectives of space research in Canada.
50. The report pointed out the importance of space technology in Canada in view of its needs for satellites for television and telephone services to the north, for augmenting communications east and west, for surveying natural resources, for surveillance of weather, spotting forest fires and ice in shipping lanes. It also discussed the uniqueness of the upper atmosphere over Canada.
51. The study Group made recommendations concerning the organization of upper atmosphere and space activities, orbital launch vehicles, space facilities, satellite communications, industrial development and production and the university institutes and research groups. Included in these recommendations were the following:

Special Committee

- (a) that a central coordinating and contracting agency for space research and development be established;
- (b) that steps be taken to ensure continuing Canadian control of domestic communication; and
- (c) that Canadian rights to station satellites in synchronous orbit locations between 75°W and 115°W longitude be established by international agreement and taken up by occupation within a reasonable time.

The report was submitted to the Science Council.

Water Resources

52. The study of water resources research was the beginning of a more general program on the application of science to the area of natural resources. An additional reason for initiating a study in this field was the increasing concern about water pollution and widespread discussion of water export to the United States.
53. The study group, headed by Mr. J. P. Bruce, of the Department of Energy, Mines and Resources, charged with the task, submitted a report that was published in July, 1968 as Special Study No. 5 entitled "Water Resources Research in Canada". This report was considered by the Committee on Water Resources Research, established by the Science Council. The Science Council formulated its own recommendations in a report entitled "A Major Program of Water Resources Research in Canada".

54. Special Study No. 5 pointed out the important role of water resources in the Canadian economy, the necessity for wise and efficient water management, and the needed research effort in the field. The study group recommended an average increase of expenditures in water resources research of 20 percent per annum. More rapid rates of growth were recommended in the fields of precipitation, stream flow, the environmental aspects of water pollution, ground water management, economic and social sciences aspects and on network design and instrumentation. Although the study group found the distribution of research effort by sectors of the economy reasonably appropriate, it recommended a slightly higher rate of growth for the university and private sector, and a somewhat lower rate for federal intramural research. The report also suggested mechanisms for the coordination and funding of water resources research.

Agriculture

55. The Agriculture Study was set up in order to obtain an objective examination of the status and structure of research in agriculture and a set of guidelines and recommendations for its future direction. Agriculture being one of Canada's most important industries, and research being vital to its continued health, this study received a high priority.
56. A proposal for the study was considered at the Science Council's first meeting, on July 5, 1966, and at its seventh meeting, on June 19, 1967, a committee was constituted to examine the findings of the study group.

57. The study group, headed by Dr. B. N. Smallman of Queen's University is charged with appraising, evaluating and making recommendations on the current status and adequacy of agricultural research in Canada, assessing the trends and needs of Canadian agriculture, and recommending on the allocation, organization, management and coordination of the national effort, including all components.
58. The study group is now examining data obtained from a questionnaire in the spring of 1968 and the final report is expected early in 1969.

Transportation

59. This study is concerned with determining the most effective contributions that science and technology could make in developing transportation systems suited to Canadian requirements between now and the end of the twentieth century, and how national resources for research and development can best be harnessed to that development. To these ends, an attempt will be made to forecast the demand for transport in Canada during this period, and to classify the demand in terms of geography, volume, density, and frequency. The study will review all possible modes of transportation in the light of current and impending technological developments to see how each segment of the demand might best be satisfied in terms of economic and social values.

60. The project is being undertaken in stages. The first is an inventory of research on aspects of transportation at present in progress in Canada in each of the following areas: universities, consultants, equipment manufacturing industry; transport operating industry; Federal, Provincial and Municipal governments. This phase was to be completed early in 1969. No schedule for subsequent phases has yet been established.

Aeronautics

61. This study is to examine the current Canadian research and development activities in the field of aeronautics and to relate these activities to probable future needs in both the military and civil sectors. In particular, the Study Group, headed by Dr. J. J. Green, Director of Research, Litton Systems Canada, will attempt to assess the requirements for research and development facilities and for the setting up of coordinating and advisory systems to meet these needs.
62. The third category concerns a miscellaneous group of studies and includes the background study on the scientific and economic evaluation of the proposal for an Intense Neutron Generator, the studies of Support of Research in the Universities and of Scientific and Technical Information, and the study on Engineering Research in Canada.

Intense Neutron Generator

63. The proposal for an Intense Neutron Generator by Atomic Energy of Canada Limited resulted in a request by the Minister of Energy, Mines and Resources to the Science Council to review the proposal. The Council appointed an ad hoc committee which studied the proposal in detail with the assistance of Science Secretariat staff and consultants.
64. The report prepared by the committee provided the material on which the Science Council based its conclusions and recommendations, and has been published as Science Secretariat Special Study No. 4.

Support of Research in the Universities

65. This study was undertaken at the request of the Science Council of Canada and the Canada Council and directed by Dr. J. B. Macdonald, former President of the University of British Columbia. The study group has examined the broad purpose and objectives of the government and the universities that should be served by the research support program, the principles and policy that should be adopted in attaining these objectives, and the organization, mechanisms and management practices that will best meet the principles and objectives that are defined by the study.
66. Communication with the Science Council and Canada Council is through a special committee made up of representatives of the humanities, social sciences and natural sciences, under the chairmanship of Dr. Roger Gaudry, vice-chairman, Science Council of Canada. The report of the study group will be completed early in 1969.

Engineering

67. Following the concern expressed by the Engineering Institute of Canada, the Deans of Engineering of Canadian universities and others, the Science Council set up a committee on Research in Engineering and initiated a study of the relevant research in the three major fields, namely universities, government institutions and industry. Of particular concern are the relationships between these fields of activity and the effectiveness of research in engineering in meeting national needs.

Scientific and Technical Information in Canada

68. This study was undertaken partly in response to representations by the Canadian Manufacturers' Association and the Engineering Institute of Canada for more comprehensive information services as well as in part to provide guides for the direction and expansion of such services by federal departments and agencies. In addition the ever-increasing amount of information books, publications and papers, as well as the technology being introduced in the handling of information made imperative a comprehensive study of this field. The terms of reference of the study are such as to include a review of existing techniques for handling scientific information and the understanding of the present pattern of information exchange and the probable pattern for future growth and development with particular reference to the use of computers and automated systems. In the light of the findings the study group will formulate a long-term policy and programme for the evolution of a coordinated national information system with guidelines to assist departments and agencies in

in this kind of work. Implicit in the study are, of course, the potential guidelines for action by independent institutions and agencies at other than the federal level. The work of the study group on scientific and technical information, headed by Mr. J.P.I. Tyas, of the Department of Industry, was completed at the end of 1968 and a report will be published early in 1969.

69. The Science Council of Canada has established a committee chaired by Professor Leon Katz, of the University of Saskatchewan, to receive this study and to consider for the Council possible policy recommendations arising out of it.

Expenditures Associated with Activities

70. Operations of the Science Secretariat started during fiscal year 1964-65. Only a relatively small amount of funds was being expended during that year and the following year 1965-66. No studies were undertaken during those years and the expenditures incurred during the first two years have been listed under operating expenditures in Table 1. During fiscal year 1966-67 the first nine studies were initiated. The expenditures for studies have been listed separately in Table 1. The operating expenditures for the Science Secretariat and the Science Council have been listed separately for each year since 1966-67. On the other hand, the expenditures for studies are totals for the Science Council and the Science Secretariat. Consequently, the total in Table 1 gives the combined expenditures for the Science Council and the Science Secretariat.

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TABLE 1
TOTAL EXPENDITURES
SCIENCE SECRETARIAT & SCIENCE COUNCIL

	1964-65*	1965-66	1966-67	1967-68	1968-69*
Operating expenditures	36,459.70	148,096.32	274,462.96	375,706.68	191,078.79
Science Secretariat			68,984.84	122,305.85	60,424.01
Science Council			71,767.86	105,920.96	32,779.26
Agriculture			5,308.29	73,170.78	69,149.70
Basic Biology			22,895.88	4,102.22	
Upper Atmosphere & Space			2,851.47	70,514.64	10,161.21
Water Resources			45,000.00	35,004.57	2,189.00
Chemistry					
Support of Research in					
Universities			237.50	85,388.73	59,719.89**
Intense Neutron Generator			1,883.56	10,919.20	
Physics			20,000.00	5,215.57	
Scientific & Technical					
Information				104,953.97***	62,508.57
Task Force Satellite				21,511.03	
Communications					
Earth Sciences					11,715.40
Astronomy					14,475.42
Engineering				32,862.50	7,891.49
Psychology				14,243.39	
Transportation			6,798.00	14,092.96	9,791.76
TOTAL:	36,459.70	148,096.32	520,190.36	1,075,913.05	531,884.50

* to 31 August 1968 only

** Science Council paid \$16,837.06 of this amount, the remainder was supplied by the Canada Council.

*** Science Secretariat paid \$57,680.50 of this amount, the remainder was supplied by the Department of Industry.

PUBLICATIONS

Special Study No. 1
February 1967

Upper Atmosphere and Space
Programs in Canada

Special Study No. 2
May 1967

Physics in Canada: Survey and
Outlook

Special Study No. 3
September 1967

Psychology in Canada

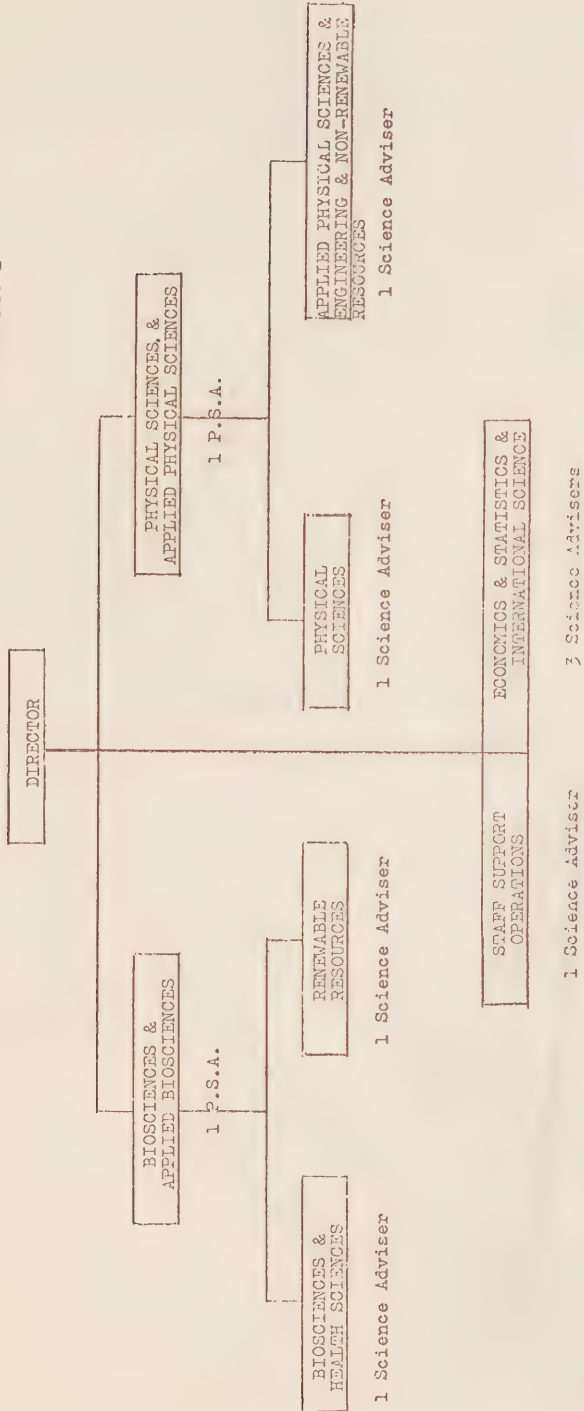
Special Study No. 4
December 1967

The Proposal for an Intense
Neutron Generator: Scientific
and Economic Evaluation

Special Study No. 5
July 1968

Water Resources Research in
Canada.

CHART NO. 1





First Session—Twenty-eighth Parliament

1968-69

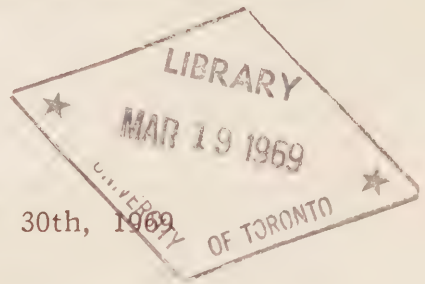
THE SENATE OF CANADA
PROCEEDINGS
OF THE
SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

The Honourable DONALD CAMERON, *Vice-Chairman*

No. 23

THURSDAY, JANUARY 30th, 1969



WITNESSES:

The Bank of Canada: Louis Rasminsky, Governor; George E. Freeman, Chief, Research Department; Dr. George R. Post, Deputy Chief, Research Department; and Dr. Ian A. Stewart, Research Adviser.

APPENDIX:

24.—Brief submitted by The Bank of Canada.

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Hays	O'Leary (<i>Carleton</i>)
Belisle	Kinnear	Phillips (<i>Prince</i>)
Bourget	Lamontagne	Robichaud
Cameron	Lang	Sullivan
Desruisseaux	Leonard	Thompson
Grosart	MacKenzie	Yuzyk

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday,
September 19th, 1968:

“With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the
Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted
for that of the Honourable Senator Argue on the list of Senators serving
on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

THURSDAY, January 30, 1969

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 3.30 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Grosart, Hays, Kinnear, Robichaud, Thompson and Yuzyk—7.

Present but not of the Committee: The Honourable Senator Haig—1.

In attendance:

Philip J. Pocock, Director of Research (*Physical Science*).

Gilles Paquet, Director of Research (*Human Science*).

The following witnesses were heard:

THE BANK OF CANADA

Louis Rasminsky, Governor;

George E. Freeman, Chief, Research Department;

Dr. George R. Post, Deputy Chief, Research Department; and

Dr. Ian A. Stewart, Research Adviser.

(A curriculum vitae of each witness follows these Minutes.)

The following is printed as Appendix No. 24:

Brief submitted by the Bank of Canada.

At 5.35 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Rasminsky, Louis, C.C., C.B.E., B.A., LL.D., D.H.L., D.C.L. Louis Rasminsky has devoted his career to the fields of international economic affairs and central banking. He joined the staff of the League of Nations in 1930 serving as a specialist in monetary and banking matters. In 1940 he joined the Bank of Canada. He organized the Research and Statistical Section of Canada's Foreign Exchange Control Board and in 1942 became the Board's Alternate Chairman and Chief Executive Officer. He was Executive Assistant to the Governors of the Bank of Canada from 1943 to 1954. Mr. Rasminsky was appointed Deputy Governor of the Bank of Canada in 1955 and Governor in 1961. He was reappointed to second term in 1968. Mr. Rasminsky is Alternate Governor for Canada of the International Monetary Fund, of which he was an original Executive Director, serving in this capacity until 1962. He had been Chairman of the Drafting Committee at the Bretton Woods Conference which approved the IMF Articles of Agreement. He was also an Executive Director of the International Bank for Reconstruction and Development from 1950 to 1962. Mr. Rasminsky was a member of the Canadian Delegation to the United Nations Organization founding conference and to the first meetings of the UN Assembly and the Economic and Social Council. He has participated in Commonwealth Finance and Economic Conferences since 1949 and in the meetings of the Joint Canada-United States Trade and Economic Affairs Committee and of the Canada-United Kingdom Continuing Economic Committee. Mr. Rasminsky was made a Companion of the Order of Canada in 1968. Born in Montreal, Quebec, in 1908, Mr. Rasminsky was educated at the University of Toronto which granted him an Honorary LL.D. in 1953, and the London School of Economics, of which he was made an Honorary Fellow in 1959. He is an Honorary Doctor of Humane Letters, Hebrew Union College, New York. He was also made an Honorary LL.D. of Queen's University, Kingston, in 1967, and an Honorary D.C.L. of Bishop's University, Lennoxville, in 1968. He was selected as the recipient of the 1968 Outstanding Achievement Award of the Public Service of Canada.

George E. Freeman: Chief, Research Department; 1941, B.A. University of Manitoba; 1946, M.A. University of Toronto; 1942-45, R.C.A.F.; 1949, Joined Research Department, Bank of Canada; 1955, Assistant Chief, Research Department; 1962, Adviser, Research Department; 1965, Chief, Research Department.

Dr. George R. Post: Deputy Chief, Research Department; 1956, B.A. Queen's University; 1962, Ph.D. Northwestern University, Chicago; 1962, Joined Research Department, Bank of Canada; 1966, Assistant Chief, Research Department; 1967, Deputy Chief, Research Department.

Dr. Ian A. Stewart: Research Adviser; 1953, B.A. Queen's University; 1954, M.A. Queen's University; 1954-56, Rhodes Scholar, Oxford; 1962, Ph.D. Cornell University; 1962-66, Professor of Economics, Dartmouth College; 1966, Joined Research Department, Bank of Canada; 1967, Research Officer; 1968, Research Adviser.

THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY EVIDENCE

Ottawa, Thursday, January 30, 1969.

The Special Committee on Science Policy met this day at 3.30 p.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, I know that some of our colleagues cannot be here this afternoon for various reasons, including the flu. We do not know exactly if it is the Hong Kong or Canadian variety, but it is certainly a reality within our own institution.

This afternoon we inaugurate another aspect of our inquiry because I believe that our guests, the representatives of the Bank of Canada, are the first to appear before this committee having a direct interest in research in various aspects of economics and economic policy. Up to now we have concentrated mainly on the efforts we make in the field of the physical and also the life sciences.

We had a short view of one particular aspect of research in the general field of the social sciences when we had the Department of National Health and Welfare before us, but the Bank of Canada is really the first institution to appear before our committee having a very direct interest in economic research. Its officials are, perhaps, lucky that we have not yet developed too much expertise in this new field of inquiry.

The delegation from the Bank of Canada is headed by a gentleman whom I am sure you all know, a very distinguished public servant who has recently received a great honour, Mr. Louis Rasminsky. He is accompanied by Mr. George E. Freeman, Chief of the Research Department and Dr. George R. Post, Deputy Chief of the Research Department, and Dr. Ian A. Stewart, Research Adviser. As you can see, all three gentlemen are very young, at least in my own judgment, and this I am sure reflects the content of the brief that we have before us, the new approach that the Bank has been trying to develop.

Mr. Rasminsky will first make a brief opening statement and then we will have the usual question period.

Mr. Louis Rasminsky, Governor, the Bank of Canada: Mr. Chairman and honourable senators, I

would like to begin by expressing my pleasure and the pleasure of my associates at being here today. Senator Lamontagne said that we were lucky to be the first to appear in connection with your consideration of economic research. I hope that will turn out to be the case. We have not had the advantage of knowing or preparing ourselves for any particular lines of inquiry that are in your minds, but I hope that we will be able to answer your questions.

I am, of course, particularly glad that I have my young colleagues here with me who are engaged in the research process in the bank. I, myself, am just a plain central banker and I am sure if the questions are at all difficult I will be turning them over to one or another of my colleagues. I take it that you have had an opportunity to look over the brief and the supplementary material which was submitted to the committee, and I am not proposing to try to cover the same ground in these introductory remarks, but there are a few additional comments that I would like to make at this time.

We have tried in our submission to give you a reasonably clear picture of the present character and scale of research activities at the Bank of Canada and I think it will be evident from this description what sort of approach we, at the central bank, have developed over time to the fundamental questions about the nature and scope of our research activities. To an important extent, our research effort is directly geared to the needs of day-to-day decision making in the various areas of policy responsibility in which we operate as a central bank. I believe that the submission itself may have given the impression that a very large proportion of our research effort is devoted to—at one point in our brief it is described as basic research with the use of electronic equipment.

This is a matter that I would imagine you will want to come back to later, because it is the case that although we attach a very great importance to this part of our effort, the great bulk of our research work in the bank is not of this character, but is what it always has been since the inception of the bank, directly geared to the immediate operational requirements of the bank in its role of central bank or in its role of adviser to the Government on the broad range of financial and economic policy.

The transactions that we are responsible for in financial markets amount, as you will realize, to many hundreds of millions of dollars a year and in order to help us to do this part of our job properly we know that we have to have immediately available within our organization enough resources of specialized information, knowledge and, of course, judgment. Beyond its own operational responsibilities, the bank also has important advisory duties in the field of national economic and financial policies. These also, of course, can have a very profound influence on the behaviour of the Canadian economy. For example, a difference of one per cent in national income in a year amounts to something like two-thirds of a billion dollars. A difference of one per cent in the cost of living in Canada in a year amounts to something like \$400 million in terms of family budgets across the nation. A difference of one per cent in the unemployment rate amounts to something like 80,000 jobs.

I certainly would not want to leave the impression that the central bank is the only influence at work here. Far from it. But we are one of a large number of influences which do have an effect on how the economy operates.

As you certainly realize, the stakes are very large. That is why we feel, basically, that it is important for the central bank to have access to first rate economic information and analysis, in arriving at the policy decisions and the policy recommendations that it has to take and that it makes. There are broader considerations in addition to its own immediate decision making problems, that make it important for a central bank to invest resources on an adequate scale in research activities. If sensible economic and financial policies are to be identified and if they are to win broad support in modern democratic societies, they must commend themselves not only to the economists within the Government service who advise their ministers but also to informed opinion outside Government.

That is why the Bank of Canada has encouraged a steadily rising flow of intercommunication between its own research staff and outside experts, and that is why it has taken the initiative—which we have described in one of the papers submitted to you—in making available to research groups outside the bank its computer files of data and programs, its experimental model of the economy, and its research studies, which we are on the point of starting to publish.

The initial response to this offer has been far beyond any expectations that we had. The offer was made only a month or so ago and we have already received something like 2,000 requests for our staff studies and about 100 requests from various groups of academic and business economists in various countries, for our data file, programs and experimental model of the economy.

In this connection, I would like to make special mention of the very great assistance and co-operation that the Bank has received from the Dominion Bureau of Statistics, whose publications were the original source for much of the economic data recorded in the Bank's computer file.

For some time now, the Bureau has been building up on computer tape its own file of the more important economic series it publishes.

Steps are being taken now to amalgamate this file with the file we use for our own research purposes and to make the combined file available to outside users.

The Bureau is, therefore, performing a major share of the work involved in making this service available, with the Bank contributing certain financial and other data which are not produced by the Bureau but by the Bank; as well as contributing the computer programs and documentation that is required to make the service a fully operational economic information system.

Of course, we are very much aware that this joint initiative we have taken with the Bureau of Statistics does not represent more than a stop-gap response to the challenge and the opportunity that is posed by the computer revolution in the field of economic information and research in Canada.

We foresee a rapidly growing demand, both inside and outside of Government, for access via computer networks to central pools of economic data of various kinds, to computer programs for analyzing such data, and to economic models of different types for use in research.

One of the things which it may be that your committee will wish at a later stage to consider is what role, if any, and I think there is a role, public policy should play in the development of such facilities, how services of this kind should be organized and financed, where the responsibility should lie for supporting and guiding their future growth, for the benefit of economic decision-making in the community as a whole.

Obviously, there are limits to what we in the central bank can do in this regard.

The scale of our research effort at the bank is still small enough that we can operate on a relatively informal and unstructured basis. If the management of the bank does not feel that its research needs for operational and policy purposes are being served well enough, well, our research department hears about it. If our published output of the results of our basic research does not appeal to the economic community, we expect that we will soon hear about it.

The Chairman: Through letters?

Mr. Rasminsky: Or in other ways. It is difficult to predict the scale on which research activities at the Bank of Canada will grow over the next few years. We

do not envisage a substantial growth in the input of resources into research, directly related to our immediate operating needs, because they are already very well served; but this will depend to an important extent on how rapidly it seems sensible to proceed with computerization of internal data files, preparation of routine reports, etc.

We do plan a substantial increase in the amount of material that we publish and this will require some additional staff and resources. We do not envisage any great expansion of the present scale of our activities in basic research.

In this area our continuing efforts will be directed mainly towards improving the initial version of our model of the economy, to make it more useful and more realistic for policy analysis, and towards more intensive investigation of monetary and financial behaviour in this country, including the links with external financial markets.

I think that we have already made a good start in developing the Bank as a centre of excellence in this area of research, which is outward looking, which will help to stimulate and encourage work along similar lines, while avoiding duplication, by other research groups in Canada.

I would like to conclude by commenting briefly on what we are hoping to achieve as the end-product of the resources that we are putting into research at the central bank. We certainly hope to promote a better understanding, both inside and outside the Bank, on what is involved in questions of public economic and financial policy and we hope that this will lead to better decision-making in this area.

But our aim in connection with this basic research is perhaps less to produce immediate answers to today's problems than it is to produce well trained and experienced people who have an interest in, and something to contribute to, the quality of financial and economic policy making in this country.

The Chairman: Thank you very much, Mr. Rasminsky. Senator Robichaud will lead the discussion.

Senator Robichaud: Mr. Chairman, having been asked to lead the discussion, I must agree with you that we have not developed expertise in this new field of inquiry, and I can assure you that this applies particularly to me.

We are certainly pleased to learn from the brief which was distributed to us that in recent years the Bank of Canada has greatly expanded its internal program of economic and financial research.

Mr. Rasminsky, my first question—from a plain layman senator to a plain central banker—would be this: how would you describe in more detail the econo-

metric model of the Canadian economy which is mentioned in your brief and which you have referred to in your remarks?

Mr. Rasminsky: I would describe it by asking one of my colleagues to do so. Dr. Stewart.

The Chairman: I think this is a very important question and I would like to add perhaps a little bit to what Senator Robichaud has just said. I know, for instance, that research in econometrics had begun already in the Department of Trade and Commerce back in the late 1940s. I would like to know, as you explain this in more general terms, why this work apparently did not progress very rapidly until recently. The Bank of Canada had more or less to pick it up. When was this effort started? Of course, as Senator Robichaud has asked, what are more or less the results up to now?

Dr. Ian A. Stewart, Research Adviser, The Bank of Canada: I will try to deal with each of those points. Perhaps I can begin by giving you a thumbnail sketch of what an econometric model is, which I take it is one of the aspects of Senator Robichaud's question. It is an attempt to portray economic activity in the country by means of a related set of equations that depict in some sense the activity of various sectors of the economy, and to relate these together in a model which somehow attempts to capture the simultaneity or the related character of activities in various areas of the economy. Once one does this one is immediately dealing with a picture, if you like, a broadly aggregated simulated picture, of the economy which demands for its operation, its solution and its ability to answer the kinds of questions we would like to ask of such a tool with its rather deep mathematics the rather intensive use of large-scale scientific computers, because you are involved essentially in solving a problem in simultaneous equations. It was difficult enough when they were linear to do them by hand. These are largely non-linear systems. The model we currently operate in the bank is a model of some 100 equations approximately; presented in computerese for the computer it becomes very close to 150 equations.

On the scale of econometric models which have been developed in this country and elsewhere this is a moderate sized econometric model. I stress that it is highly aggregated and tries to deal with the main aggregate of activities, and attempts to deal specifically with the Bank of Canada's situation. It has a comparative advantage where our interests lie; it connects fiscal and monetary policy to economic activity generally in the country. We have put a good deal of labour and our resources into trying to expand these sectors of the model to capture in some reasonable way, or what we think is a reasonable way, the links, between these kinds of activities.

Senator Grosart: You use the word "model". What does it look like?

Dr. Stewart: I have brought a copy of it along. It can be written on paper. It is an equation system; that is, a system which comprises some 100 equations.

The Chairman: I ought to tell you that Senator Grosart is an expert on this.

Senator Grosart: On models? Some kinds only.

The Chairman: On equations.

Senator Grosart: The word "model" intrigued me.

Dr. Stewart: It is a model in the sense that it does not claim to represent reality precisely and to scale.

The Chairman: It is a simplified version of the working of the economy.

Dr. Stewart: Indeed it is. A model overlooks a good many of the influences that we know affect individual and group behaviour in the economic world, in the hope that these influences cancel out in a probabilistic sense, that they do not affect behaviour in a different way from those we do account for.

Mr. Rasminsky: Do you mean later to give some concrete examples of the types of equations introduced into the model?

Dr. Stewart: Yes indeed.

Mr. Rasminsky: I think it might be helpful if you were to do that.

Senator Grosart: If Dr. Stewart was not going to, he was going to be asked some questions.

Senator Robichaud: It was the second question I had in mind.

Dr. Stewart: I think probably the simplest example, and one you have perhaps all heard of, is the consumption function. When you think of aggregate consumption behaviour in Canada, the consumption of durable goods, you ask yourself, "What are the major factors that in a sense explain how individuals behave when it comes to making decisions on the consumption of durable goods?" It is not difficult to tick off most of the major factors: their income is very important; their wealth may be important; the current cost of credit in the market may be important, and where they stand in the income structure may be important. There may be other important influences, and growing out of economic theories are theories covering most aspects of economic behaviour in our economy which are, if one struggles, quantifiable in the sense that one

can attempt to prove or disprove whether these are rational explanations of individual behaviour, or individual behaviour aggregated over the whole economy. One can try to find out whether they were useful devices for predicting, for example, the level of consumer durables spending if one knew the level of income. One could test their usefulness theoretically by their ability to predict, or in a historical sense explain what actually has occurred. That perhaps is the simplest example.

Imports are a critical factor in the Canadian economy. We attempt to explain the level of imports in this model by making it a function of—making it determined by—the level of investment in gross capital, the level of consumption, the level of government non-wage expenditure and the level of inventory accumulation taking place in Canada at the time. It is also directly related, we believe, to the degree of utilization of Canadian productive capacity that is taking place at the time. It is also related to prices, domestic prices compared with foreign prices. Once again it is possible to take all these related explanations, all these factors that are clearly critical in the level of imports into Canada, to attempt to represent their influence mathematically, to attempt to use historical data that exists for all these activities, to try to estimate by statistical means equations which represent the relative weight of each explanatory factor in determining the total level of the import of goods at any point in time.

Again, the model is aggregated, it is over-simplified, it leaves out a good many of the explanatory factors that we know are important and that we have inadequate measures of at the moment, or the effect of which, for simple statistical reasons, it is very difficult to capture precisely in these equations. There are enormous statistical problems in the econometric field which arise from the fact that when the economy goes up everything goes up, and when the economy goes down almost everything goes down. It is very difficult to dissociate the relative marginal influence of the various factors that one chooses to incorporate in the explanation of economic events. I would be happy to pursue at greater length the nature of the model.

Senator Grosart: I am following you.

Dr. Stewart: Perhaps I could go on to Senator Lamontagne's question. Part of the question is what has become of the Department of Trade and Commerce model and the work that began in the Department of Trade and Commerce in the late 1940s. That model still exists. It is now in the Department of Finance and is being used and developed in that framework.

I think there are two sorts of answers to this question. One is that there is clearly room for more than one econometric model. It is difficult to establish within the economic community a set of relationships or equations or theories about economic behaviour which is mutually agreed upon by all economists. Mo-

dels can be used for different purposes. Ours, as I have stressed, is designed to be useful to ask questions about fiscal and monetary policy, with which we have a direct policy concern. Other models may be designed, and because of the interests served would be designed, in a different way, exclusively to predict economic behaviour. If the Bank of Canada were to choose to use its model for predictive purposes, for forecasting economic trends, it would have been designed and evolved as a different economic model.

I think the answer is primarily that there is room for more than one model, and it is our hope, and the notion stems from our brief, that the model we have developed may form a useful basis for sharing with the rest of the economic community, the academic and non-academic economic community, in Canada, in the hope that in one stream perhaps this will grow and be a better model in the sense of capturing the economic realities better than the one we now have currently does. It may also for some reasons develop into quite a different model taken over by the financial community, or taken over by the investment community, or taken over by the industrial community.

Models will obviously be modified and adapted to answer questions that are of interest to these sorts of people rather than to those of us who are concerned primarily with being able to ask and gain answers to—at least in this hypothetical world—questions of the effects of public policy, broadly speaking.

The Chairman: Senator Robichaud, I wonder if instead of having a more detailed explanation of the model this afternoon, it would not be more useful if the Bank were, at some stage, to add to its presentation by way of an appendix?

Mr. George E. Freeman, Chief, Research Department, The Bank Of Canada: We are planning to publish a detailed description of our model in the forthcoming series of our research papers, together with an account of some of the experiments conducted with it. We expected the first of our studies to come off the press momentarily, this week in fact, and work is underway on other studies which we expect to follow along fairly quickly. We have circulated a description of the model on an informal basis to various professional economists in Canada and abroad. We have not really, at this stage, developed a carefully written final version of a paper describing it. This will be available shortly within a matter of a few months.

The Chairman: In a few months?

Mr. Freeman: In a couple of months we hope.

The Chairman: Could you make available to the committee what you have given to these economists?

Mr. Rasminsky: Yes, certainly.

The Chairman: Perhaps in a few months, as we do not intend to remain in business here indefinitely.

Mr. Rasminsky: We would like to reserve the publication rights. We want this to appear first as one of the staff studies.

Mr. Freeman: This will be the third.

Mr. Rasminsky: This will be about the third. The staff studies are something we have had under preparation for some time. We would like to launch it with a little bit of an announcement. I believe that the idea of publishing staff studies, where people will have their own work published under their own name, without engaging the responsibility of the bank, is basically a good idea.

The Chairman: I am sure we would not compete with you.

Mr. Rasminsky: Subject to that, we can make copies of this paper available to the committee.

The Chairman: As "Chubby" Power said one day, if you want something to remain confidential and secret say it in the Senate, so we would not be competing with you

Senator Grosart: Would you complete the rest of the quotation.

The Chairman: If you want something to be known say it in Cabinet.

Mr. Rasminsky: I recall during the war in 1941, just before the Americans adopted the program of mutual aid, which was occasioned by the fact that the British had run out of dollars, the UK Treasury handed a statement of their financial position to the United States Treasury which some time later was published in the *New York Times*, still bearing the security rating "confidential". No one paid very much attention to it.

The Chairman: There was some precedent in this respect too, in the House of Commons some years ago. Thank you very much.

Senator Robichaud: I wish to thank Dr. Stewart for the description he has given us of the econometric model, and I would like to follow up with a related question. He has given us a few examples of what it could do or may do. Now, do I understand from the description that he has given us that, say, for example, you can go as far as to postulate a certain course of action, such as an important change in the money supply, and through the econometric model obtain an assessment of the effect that this change would have upon other pertinent factors, say, in our economy?

Dr. Stewart: I think for those of us who hold the faith, senator, that is our ultimate object. It perhaps ought to be stressed that the version of the model we are currently releasing is very much an experimental version although we are anxious to have the rest of the community play with it to see if it will answer or provide answers to questions that are of interest to them.

We will continue our own strand of development of this model and, as it will become known, we have named it RDX1, and which stands for Research Department experimental mark 1. Hopefully over time this will go to mark N and perhaps somewhere along that line it will become a device in which we feel some degree of assurance about its ability to give sensible answers to questions of the sort you propose. That certainly was the ultimate purpose and intention of the design. We would be the last to say we are happy at the moment with its ability to answer any—to provide answers that any of us would be very comfortable about, to the sorts of questions you ask. Gentlemen, that is its purpose.

Mr. Rasminsky: I think, senator, this is confirming what Dr. Stewart has said, that we are some time away from the ability or any intention of using this model for predictive purposes of that sort. We regard this work as developmental and as experimental. I am sure that the model itself will be changed in the course of time. Its ability to act even when it is perfected, its ability to act in the way that you have indicated in your question depends, of course, upon a continuance into the future of the relationship between the various variables that are incorporated into these hundred equations, as obtained in the past. That is, I suppose if one had to make a single assumption about what the relationships among variables in the future would be, the best single assumption one could make—that they would continue to be what they have been in the past. That is an assumption. So far as the actual performance of the economy is concerned, it is very much influenced, as we all know, by expectations and changing expectations. It is very difficult to incorporate expectations as such into a model, although the econometricians will try to get proxies for them, but we have seen quite recently how the behaviour of consumers, who are so important in the economic process, can be different from what was expected. It was expected when the American surcharge on income tax and other taxes went into effect in the middle of last year that this would have an effect on consumer spending, because take-home pay was reduced, and that the economy would tend to slow down. This did not happen because consumers acted differently. They drew on their savings and the economy advanced more rapidly after the tax than it did before.

The Chairman: Not because of the tax.

Mr. Rasminsky: No, it was not because of the tax; it was because of the reluctance of consumers to change their spending habits. Now, it is the case that in the fourth quarter of the year consumers tended to revert to the old saving rates so that there may have been a little wiggle; that may have been an aberration. If one could correctly predict shifts in expectations, ultimately of course it would be perfection and would make one's job much easier. You could feed the information into the computer and come out with the answers as to what policy should be.

What the model does essentially is produce an internally consistent result. This is the consequence of the nature of the process, the fact that the machine solves a hundred simultaneous equations at the same time. It produces an internally consistent result. If you want to say that one of the things that you want to feed into the computer is that the money supply is going to rise by X per cent in the next year then you can get, within a very short time, an estimate of the effects on everything else. That is the only new information that you feed it. You will get a print-out showing these effects, assuming that the money supply is one of the variables in the equation. It would be in your case.

The Chairman: It would be?

Mr. Rasminsky: It would. You get a print-out showing how everything else has changed, and you will have an indication of what the behaviour or what the state of the economy will be, which adds up—the sums are correct, it is internally consistent, but it will not necessarily be the right answer.

Mr. Freeman: Mr. Chairman, could I add one point on this, the fact that the Bank of Canada has got into experimenting with a model built over the past three years is by no means a novel departure, if one is talking about what is going on in professional economics throughout the world. There is a history of twenty years in this kind of work being carried out in Brussels, France, The Netherlands, in models of this kind.

Senator Robichaud: What about the United States?

Mr. Freeman: In the United States, there are half a dozen large scale models established now, and many others under development. Our interest in getting into it was partly to try and learn the problems involved in constructing such a model in the Canadian context, teaching ourselves the statistical problems we had to overcome, and the problems of the designing of such a model, and in learning, when you can see that it was giving you poor results, how to improve it. Much of it was to catch up through own effort with current methodology in the economic community.

The Chairman: How many models have been developed within the Canadian Government, do you know, or would it be confidential information?

Mr. Freeman: There was the one which the Department of Trade and Commerce started, which was an annual model: ours is the only quarterly model I am aware of. I believe the Economic Council has its model.

Dr. Stewart: We ought to be careful again about the designation of models. These are models of general economic activity. The National Energy Board has constructed a model for the consumption of power. I am sure that there are in the Department of Agriculture models for specific purposes.

The Chairman: For specialized purposes?

Dr. Stewart: Yes, for general matters.

Senator Yuzyk: How long has this model been in operation and have you made modifications during that period of time?

Dr. Stewart: The first version of the model RDX1 was completed lately, in the last year, and it has since been in operation, in the sense that we have played many games with it, tried to see how it reacts to various kinds of impulses, and reacts to impacts on it. We have learned a great deal from this process, identifying areas we are unhappy about and which need further development, and we are anxious to make the model available to the community at large, receive their criticism and experiences with it. It is rather an inevitable instinct that in these models one would wish to go on tinkering forever and one is never happy. We decided to draw the line and call it RDX1, but the RDX1 within the Bank of Canada is no longer RDX1 but RDX1.5.

Senator Yuzyk: Does it mean that these equations—I have not seen the model—change from time to time?

Dr. Stewart: Yes.

Senator Yuzyk: You adapt, or create new equations?

Dr. Stewart: You create new equations or adapt the ones you have. You feel your picture is inadequate, in a sense.

Mr. Freeman: You are quite often forced to revise, because the data is revised and you have to re-estimate your equations and get a somewhat different equation.

The Chairman: That is very frustrating, especially when it comes to the point that you get a new series from the DBS.

Senator Yuzyk: The computer is sometimes very handy, then, to show if you are a little off?

Mr. Freeman: It is, in deed, and in many of the results given by parts of the model, if one does not believe them one can go back into the model, and it should be extremely easy to find out which are the sensitive equations. Now, if we find that the model is too sensitive to market prices, we will modify that equation. It is a developmental process. We have only just begun.

Senator Robichaud: You mentioned that such models are in existence in the United States of American and we hear so often that the U.S. economy has an effect on our own Canadian economy. What access do we have to the computer information which they are taking in the United States?

Mr. Freeman: Two of the consultants working on the design of our model have had experience on models in the United States. They were pioneers in the United States in the model constructed partly by the Federal Reserve Board, which is the American Central Bank, in conjunction with the group at the Massachusetts Institute of Technology, and also a model that was developed in the University of Michigan. So we have the very closest relations.

Senator Robichaud: You are talking about the model proper, but do we have access to the information?

Mr. Freeman: The United States economic data? Yes, to their models and to their economic series.

Mr. Rasminsky: But I think it would be fair to say that we do not have quite as direct access to the input into American models as we are providing to others, in the arrangement we have recently made to make our data bank and our equations, our model, available to the public. We cannot, by remote terminal, simply tune in to the American models in the way we are making it available for Canadians and other Canadian researchers.

Senator Yuzyk: It could be done in the future, by some arrangement?

Mr. Rasminsky: It could be done in the future, if others make their basic data available in this way.

Senator Robichaud: Do I understand, Mr. Rasminsky, that it is not quite sufficient, then, to enable us to calculate the effects or probable effects of United States factors on our economy—at this stage, or its present stage, is it not complete enough?

Mr. Freeman: We are no further in practice on the effect of these influences than we are in respect of specifically Canadian ones. The United States data

goes into our model and is part of what drives it, just like the Canadian statistical series.

Dr. George R. Post, Deputy chief, Research Department, the Bank of Canada: We might point out that one of the objects of continuing Canadian research towards RDX2 or X3 is the idea of having some closer liaison with American model building groups. There has been already some preliminary discussion between model builders in Canada and the United States, in an explicit effort to link up what we are already doing with what other people there are already doing, to have what might be described as a model of economic activity in North America. There are a lot of problems for research—it has not yet progressed, it has not been started.

Senator Robichaud: Following again this information on the computer, at page 8, the last line, and at page 9, sections 15 and 16 of the brief, there is a suggestion of a centralized bureau of economic data on computer files through the Dominion Bureau of Statistics.

While this seems to be a good idea, what I would like to ask is, is there any problem, holding up the implementation of this idea, which appears to be a good one.

Mr. Freeman: There are many problems. One is that it is not at all clear to us where in fact a service of this kind should in fact be performed within Government departments, or whether it needs to be specifically a Government agency that would have the responsibility for trying to make available a central pool of economic data, plus the economic programs that you need to analyze it, plus models of various kinds.

It does seem clear enough that there are many economic series that the Bureau of Statistics already publishes, which would be useful for other people to be able to tap into directly, and in fact that arrangement is going ahead on some scale. We will shortly be able to provide a service like that between ourselves and the Bureau, and it is quite possible that we can start out with as many as 10,000 of the economic and financial series. When one goes beyond that, for most research you need statistics that are put into the pool, not just by the Dominion Bureau of Statistics that happens to produce data on the Canadian economy, but you also need data on the American economy, for example, and on the British economy. Somebody has to have the responsibility for putting those into the pool; once they are in the pool they become generally available. When you go on to computer programs, and so on, it is not at all clear that the Dominion Bureau of Statistics would feel that ought to be its primary job. It seems in a way to be a more natural job for a research agency of some sort, or an institute that is engaged on economic research, which generates programs of this sort as a by-product of its own research activity.

The idea of sharing with other people makes a great deal of sense because it means that universities or other centres do not have to start from scratch, although the programs may be a little bit different because of the way they develop. The same thing applies to models.

Mr. Rasminsky: I think it might be useful if you were to talk a bit about the difference between a program and a model.

Mr. Freeman: Perhaps Dr. Stewart would prefer to do that.

Dr. Stewart: I am delighted to try again. I have already alluded to the fact that the creation of a model of this kind involves the theory and use of statistics, and hence its solution involves rather complex processes, as you will recognize. All of this is performed by the computer program. As econometrics develops as a science and econometricians learn to do more and more tricks, these tricks demand a computer program that puts them into effect. What we have done at the bank is essentially to develop and collect a wide range of programs that do most of the things econometricians want to do. These are computer-coded programs that involve somebody else's input and somebody else's ideas, but they do the job.

Mr. Freeman: They are a long detailed set of sequential instructions to the computer to do this—"Now go to that location. Now go down there and take that out and put this in." It takes a great deal of work and imagination to learn how to get a computer to do what you want it to do.

Senator Robichaud: And expertise too.

The Chairman: These programs can serve a very specific purpose. They can serve also to develop a model which . . .

Mr. Freeman: You have to have a data file on computer tape. You have to have a set of instructions so that you can put data into the file, so that you can revise it, update it and get it out of the file.

There are obvious advantages in having a certain amount standardization of these types of computer programs, so that they are not using slightly different ones at every different centre, so that we don't get into a situation where nobody's program will work on anybody else's equipment.

Senator Grosart: I was interested in the point Mr. Rasminsky was making, that there is a difference between the program and the computer operation.

The Chairman: The computer program and a model.

Mr. Rasminsky: A model.

Senator Grosart: Well, between the program and the computer. Somebody has to make a program for the computer; the computer does not make its own program.

Mr. Rasminsky: No, that is right. It is a very highly skilled job.

Senator Grosart: That is the point I am making. In that case, I should like to ask how far back is there validity, or reasonable validity, in our major economic statistical series. The reason I ask that is because I happen to be old enough to remember when banks were prohibited from investing in land because it was regarded as one of the highly speculative investments. I should like to know how far back our statistical series go and are valid.

The Chairman: The most complete series, would you say, would be, I suppose, back to 1926.

Mr. Freeman: They go back with steadily decreasing reliability as you go back in history, I imagine. Some series go back further than others. Some of ours go back only a few years; others go back for many years.

The Chairman: Our national economic statistics go back to 1926.

Mr. Freeman: The national income statistics go back to 1926.

Mr. Rasminsky: Yes, the national income statistics go back to 1926. Some series, of course, have more validity further back than others. Series that arise from precisely performed administrative acts, such as the series related to public accounts, to financial statistics, banking statistics, I think would be reliable far before 1926. Some series, of course, even now are deficient in quality. This is a continuing problem with this sort of thing. Some of the input that one has had to use, as you were saying before, may be subject to major revision.

Senator Grosart: That is the point I was making about programs. Surely this must be an area of constant concern to those who are creating the programs for the computer, and my rough guess is that our overall economic statistical series are not too complete.

Mr. Rasminsky: Of course, it may be that the development of these computer methods themselves will effect basic improvements in the quality of the data themselves. I would agree with the general point that I think you have been suggesting, that you might ask what is the advantage of applying sophisticated techniques to unreliable data.

I think the answer is first of all that most of our data are pretty reliable; but secondly, that as these methods

develop I would think we may be moving towards a period in which the basic information is provided through the linking up at the source of the information. For example, the individual factory through linking up with the collection agencies' apparatus in a way that will result in a much more reliable collection of information than we have now. This may be looking ahead a bit, but I think it is very much to be hoped that developments of this sort will take place.

The Chairman: As you were saying a moment ago also, I suppose you would not want to go back too far in the past.

Mr. Rasminsky: In time.

Mr. Freeman: The functions themselves change.

The Chairman: The Canadian economy has changed so much.

Mr. Freeman: The institutions have changed.

The Chairman: The institutions and centres of decision, so even if you had reliable data back to 1900, for instance, usually you would not be able to use them in order to produce the results you would expect from your models for intelligent decisions now.

Senator Grosart: The point I was making was rather contrary to that viewpoint. I think it is important that you be able to go far back. *The Decline and Fall of the Roman Empire* is a pretty useful document today if you want to study where we are going.

The Chairman: Not for your computer.

Mr. Rasminsky: That is right. I do not think the programmers could do it.

Senator Grosart: I think it would be very useful to put some of the current social data into the computer and see what comes out.

Mr. Freeman: It is certainly true that with the arrival of the computer we can now actually perform much more in the way of an analysis on data than we could before. That naturally generates a demand for more and better data. I am sure everyone in the country, all the agencies who produce data, especially the Dominion Bureau of Statistics, are faced with an exploding demand from people like ourselves who say, "Now we can examine larger bodies of information. Can we have it, and have it better and faster?" This is part of their problem.

The Chairman: I suppose that the computers might be useful to explain the decadence of the Roman Empire, but that would not be very useful for us today.

Mr. Rasminsky: And, you do not need the computers for that.

Senator Grosart: I am not sure that we would not. Perhaps the difference here is that philosophically I am a conservative, Mr. Chairman.

The Chairman: You mean that Mr. Rasminsky is a Conservative or me.

Mr. Rasminsky: In the parliamentary method he was addressing the chairman, I am sure.

Senator Robichaud: Mr. Chairman, those are all the questions I had in mind regarding the model. I might have some general questions which I would like to ask later.

The Chairman: Could I ask one very general question? I am afraid I am speaking too much today.

Senator Robichaud: Not at all.

The Chairman: This is related to the guidelines that we have circulated and, as I said before, you are the first institution doing economic research and having an exclusively research operation in economics to appear. How do you react to the guidelines—I see that you sent us a supplementary paper.

Mr. Freeman: The difficulty was that when we first looked at it we thought that it seemed to us to be more applicable to a very large scientific research establishment in the physical sciences. We thought when we looked at our own operation—well that it was very difficult to describe it within your guidelines, but on reflection we thought perhaps there was some of this supplementary information which we could give.

The Chairman: You keep, for instance, the distinction in the memorandum referring to basic research and applied research.

Mr. Freeman: People do both in our shop.

The Chairman: Do you find these divisions in the different stages of research—do you find these different categories useful in economics? For instance, in our own operation—

Mr. Rasminsky: The concept of basic research in economics is not one that is familiar to me, that I find natural, though we have used the term following your brief. We have used the term basic research really in the sense of econometric research of this model building type.

The Chairman: If there is any basic research in economics this is certainly it.

Mr. Rasminsky: This is it.

Mr. Freeman: It has a long-range time horizon, it is developmental. That is really I suppose the distinction.

The Chairman: We have nothing in Canada to measure the efforts that we devote to research in the whole field of the social sciences. We will probably get some kind of information from the MacDonald Report in so far as the universities are concerned. We understand that this report will be published in March, but even within the Government we have nothing and we have discussed this and I have discussed this privately with the DBS and they will appear before us next week I think. They have tried to produce some kind of preliminary study about these concepts and it could be applied also to the social sciences, but when I read your memorandum and I am sure that you tried to follow those guidelines as much as possible, I can see that they have not been too useful to you in providing the information.

Mr. Freeman: It is pretty hard to make these clean-cut distinctions in economics, in the sort of environment in which we operate.

Dr. Post: The basic difference being that we do not segregate people into projects. Somebody who might write a brief note for the Governor today may tomorrow be fitting an equation. We are really a small shop and everybody in it is essentially doing applied research.

The Chairman: I hope they do not communicate with you in equations.

Mr. Rasminsky: They know better than to do that. They want me to understand what they say.

I wonder if I could add another word about the way I look at this basic research in the bank. This is supplementary to what is in the brief, but I know that you, Mr. Chairman, being in the old classical tradition of economics—

The Chairman: I do not know if I would fit that category, but pretty close anyway.

Mr. Rasminsky: —have some mental reservations about this.

The Chairman: No, no.

Mr. Rasminsky: No?

The Chairman: I am more progressive than Senator Grosart.

Mr. Rasminsky: I would like to register one or two points with the committee. It may be the case that our submission gave a rather over-emphasized—it gave perhaps a rather exaggerated idea of the proportion of our total research efforts in the bank, which is devoted

to this so-called basic research. I regard the Research Department of the bank as a very important operating department of the bank and I do not think there is a single operational decision that I have had to make which has been made without help from the Research Department. This help is a very important part of my ability to perform my job and the great bulk of the work of the Research Department is policy oriented. It is responsive to the requirements of the management of the Bank.

In numbers, we have 55 professionals, 55 university graduates in the Research Department. Of the 55, 40 are economists and are working as economists. The others are working as programmers or in the library or at other tasks. Of those 40 economists that we have in the Research Department five or six are engaged in this process that we have been talking about now. So this is the first point that I would like to register with the committee, that the bulk of our efforts in the Bank—and this is not by any means downgrading the basic research to which I do attach a very great importance—but the bulk of our efforts quantitatively is policy oriented and it is written language. It is in good plain English and not in the form of mathematical equations. I should say good plain English or French.

The second thing that I would like to register with the committee is that this type of basic research or econometric research is going on in many parts of Canada and all parts of the United States and there is no doubt that it is going to go on and that it will add enormously to our knowledge. Research of this type involving the operation of the financial system is bound to be done. Now, it is my view that it will be better done if it is done by people who are consorting daily with practitioners, that it will be done in a more practical and realistic way, and that is why I think it is important that it should be done in the Bank.

The third thing that I would like to say about this is an additional reason for wanting to develop this type of activity in the bank. It is that many of the brighter young graduates from universities nowadays want to do this sort of thing. They are attracted to it. It is the breakthrough, it is the new development, and the bank wants to have able people on its staff and wants to keep able people on its staff. Having attracted them, it does not necessarily want to keep them as model builders, as econometricians. We might convert them into central bankers, once we have got them but I attach a great importance to this work in the bank, as a method of attracting and retaining people of high intellectual calibre.

Senator Grosart: Mr. Rasminsky, it is obvious that there are a number of research banks channeling into the decision making and fiscal and monetary policy in Canada. The Bank of Canada is one. I think of others, the DBS, the Department of Finance, the Department of Trade and Commerce, the Economic Council, chartered banks, investment businesses. Could you

indicate the respective magnitudes of these various research banks, or, to put it another way, what is the relative magnitude of the Bank of Canada's research effort to the total effort, feeding directly into the fiscal and monetary policy?

Mr. Rasminsky: I am afraid, Senator Grosart, that I could not do that. Some of my colleagues may be able to give you some idea of relative magnitude. We have provided you in our submission with the figures of the total numbers employed, the numbers of professionals, with some description of their education and a figure in the supplementary submission of the amount of money that we spend directly, basically, the payroll of the Research Department, and the cost of computers and the cost of the library. I daresay, as others appear before you, that they would provide similar information that would enable you to make this comparison. I think it would be fair to say that on this so-called basic research, the model building exercise, I think probably we are devoting more resources to it than any other agency is in Canada.

Mr. Freeman: In Canada, in that particular type of work.

Mr. Rasminsky: In that particular type of work. I think that we are the principal.

The Chairman: But in terms of the Federal Government and general economic research, I suppose that the bank and the Economic Council would be the two main agencies doing serious general economic research?

Mr. Rasminsky: The Department of Finance, of course, is doing research, and the DBS.

The Chairman: Yes. Apart from the DBS, which has a very specific function there, which is a little bit remote from formulation of policy.

Mr. Rasminsky: No doubt some research is going on in other agencies of government as well—the Department of Trade and Commerce.

The Chairman: But this would not be on the scale you are doing.

Mr. Freeman: The Department of Labour, Manpower, and so on. I am not quite sure of the character of some of the work.

Dr. Post: There is that of Finance, which is probably more generally oriented to macro-policy. There is the National Energy Board that we mentioned which is doing a lot of research in a specific industry.

Senator Grosart: I wonder if it would be too much to ask that the bank might provide us with a

guesstimate of the magnitude. To me it is most important to this committee, because one of our functions shortly is to determine the total research requirement in various fields and then to examine it in relation to the efficiency and effectiveness of the various performance sectors. We cannot do that unless we have some estimate of the sizes of performance sectors. We can find the funding figures, that is very easy, but funding does not necessarily tell us the importance or the magnitude of the research. We have to do that, not only in this area but in many other areas. We must somehow come up, when we make a report, with some information to the Government along these lines. It is most important that we be able to say what is the magnitude of the performance sector. Could the bank, could anybody in the bank take a guess—sometime, not now? I say this because it seems to me the bank is in the best position to do it.

Mr. Rasminsky: It may be, Senator, that this is the case. I can see your desire, that you want to have that information to complete your task under your terms of reference. It may be that the best time to consider this suggestion would be after you have heard from other people in Ottawa as to the scale and character of their research, that perhaps at that time some of our own officers, if you still think that that would be desirable, might discuss with the staff of the committee, how one would go about trying to round out the picture and complete it.

The Chairman: We have had also discussions with the Dominion Bureau of Statistics, and these people will be with us next week, so perhaps we will in the near future, when we have heard from these various agencies, go back to you.

Mr. Rasminsky: Come back to us, yes.

The Chairman: And might convince you to try to co-operate in the joint exercise, because it is a great gap, it seems to me, in the whole research effort of the Canadian Government at present.

Senator Grosart: Surely the fact is that if the Bank of Canada does not know and the Government does not know, it is an impossible situation.

The Chairman: Yes.

Senator Grosart: They must know who they are relying on and how much they can rely on these various sources of information. I picked up a book a couple of weeks ago, not a recent book, by a group of Carleton professors. They were analyzing the performances of various Ministers of Finance, over a period of time, and when I put it down, I had to conclude that they are all either stupid or—I am not speaking of any particular Minister of Finance.

The Chairman: We have a professor from Carleton here.

Senator Grosart: The conclusion I took from this book is that either they are all stupid—

The Chairman: I thought you were saying that these professors from Carleton are all stupid.

Senator Grosart: No, no, the Ministers of Finance. What I took from the book is that they have all been wrong all the time.

Mr. Rasminsky: You are not suggesting that the Bank of Canada should help you to determine that?

Senator Grosart: I am saying that my problem, Mr. Rasminsky, is that I have to decide whether this impression is right or whether we are in a situation where Ministers of Finance are not being provided with the data that they need to make decisions. This is the subject of our discussion here today. The Bank of Canada is part of the data providing capacity or capability that a Minister of Finance must have. That is why I say it is important that we examine the various sectors in which this work is being done and in due course evaluate them. We cannot do it unless we have some kind of facts and figures.

Mr. Freeman: You would certainly include in this the provision of essential economic and financial information as well as more analytical types of work.

Senator Grosart: They go together.

The Chairman: All the range of scientific effort affects the collection of data and development work.

Senator Grosart: Yes, you do not have research without the data.

The Chairman: I have a question about a related field. From all the agencies that have appeared before us up to now—and they have been, as I told you before, mostly related to the physical and life sciences—we have received a list of research projects that they have carried out over the years, with the kind of priorities attached to their research programs. I notice that in your brief you speak about the general headings of your research activities at the Bank, but there is no such information.

Mr. Freeman: I think the first thing to say is that the main body of our research activities is not project-oriented. It is directly related to operating decision-making and the taking of policy decisions, and we are organized by subject-matter groups. These people act in a service relationship to management.

The Chairman: Of course, the day to day operations.

Mr. Freeman: In econometric work it is really a single attack on the impact of financial policies, on the workings of the economy at the aggregate level.

Senator Grosart: And the other way around.

Mr. Freeman: And the other way round.

The Chairman: Let us take an example. We were told in great detail—perhaps in your case it is different—the research projects undertaken by the National Research Council. In your case, what kind of research are you doing in the field of inflation?

Mr. Freeman: The central problem we are trying to attack is right in the middle of our main area of operational concern, namely how does the economy broadly work and what are the impacts on the economy of actions at the policy level. A by-product of this sort of work will be studies of processes like how prices are determined, how the labour market reacts and so on. But we do not typically divide it all up that way. A lot of the output will take the form of research monographs.

The Chairman: But ultimately these research monographs will have a title, will have subject-matter, for example?

Mr. Rasminsky: That is right. I have here a list of some of the research studies that have emerged, really to some degree as a by-product of the work on the big model, which will ultimately probably be published in one form or another. It may be of some interest to you if I read down the list. There is a study on Canadian inventory investment; a study of quarterly business capital expenditure; a model of the Canadian housing market; a study on the Government sector; a study of consumer durable expenditures and attitude indexes; an analysis of the importance of expectations on the portfolio preferences of the chartered banks; an estimation of stock adjustment for financial variables; a study of the realizations of investment forecasts; the determinants of negotiated wages; an econometric analysis of assets and liabilities of chartered banks; a study of discretionary and contractual savings in Canada. These are studies done by members of the staff of the Bank. In some cases they overlap Ph.D. theses.

Mr. Freeman: Some of them have already been accepted by economic journals for publication.

The Chairman: Will all these be published?

Mr. Freeman: The majority of them probably will end up by being published one way or the other.

Mr. Rasminsky: Most of them will be.

Mr. Freeman: Either in economic journals or by ourselves, or in some other format.

The Chairman: I see you have not exhausted the list.

Mr. Rasminsky: No, I had not exhausted the list. If you wish, I will complete it. The next study was a description of the model. There is a study of post-war production relationships in Canada; an econometric analysis of the demand for Canadian imports and exports. These are all likely to be published in some form or other.

Mr. Freeman: This is not really an exhaustive list.

Mr. Rasminsky: Quite apart from this, and much more directly relevant to current policy than this, there is a whole series of memoranda produced in the research departments which are for the internal use of the bank. They would cover a very wide field. Of course they are all basically oriented towards the responsibility of the bank in monetary management, and therefore many of them have to do with the particular problem you have mentioned.

For example, there has been a study on recent developments in costs and prices in Canada, which is an attempt on the part of the officers of the research department doing this study to form a judgment on whether there was any convincing evidence that cost increases were levelling out in Canada.

There are studies of the balance of payments and of our financial relationships with the United States; studies of recent movements of inventories; prospects for capital investment, which of course draws on material obtained from other government departments. The flow of research memoranda of that sort which are unpublished greatly exceeds the amount of material we publish.

The Chairman: Just for us as a kind of exercise, would you have any objection, not to giving a complete list of all these studies—we do not want that because these studies are confidential memoranda to you—in order that we may be in a better position to appraise the research effort which is going on within the federal Government, to letting us have at some time, not today, a list of studies which have been made that could be selected by you, which would give us at least a more detailed background.

Mr. Freeman: Including our internal output?

The Chairman: Yes.

Mr. Rasminsky: I do not see any difficulty in that. Just glancing down the list of research memoranda I have received of the second category recently, I see that yesterday there was a memorandum on net new issues of securities by Canadian borrowers in the Canadian market and in external markets in 1968.

Such memoranda would contain a lot of statistics, but they would go beyond that; they would contain come judgments as well. I see a memorandum on the automobile market; a memorandum summarizing and commenting on a survey that we are doing of chartered bank lending rates; a memorandum of payment imbalances within the Group of Ten between 1961 and 1968, because the external side is a very important part of our responsibility; a memorandum on chartered bank residential mortgage lending since May, 1967, when the banks acquired this power, up to the present; a memorandum on life insurance companies; a GNP forecast for Canada, 1968-69; a memorandum on wage settlements, on bank loans, and so on. If you think it would be helpful we would give you a list.

The Chairman: I think it would be helpful. We do not want, of course, to get into the confidential aspect of your operation, certainly not in content, but at least it would give an impression of the subject matter, let us say, over a year or something like that. If we could pick up a list of topics that have been considered rather seriously in a memorandum so as to be able to . . .

Mr. Rasminsky: Give some idea of the scope of our activity?

The Chairman: Yes.

Mr. Freeman: It might be a very long list.

The Chairman: Let us pick up perhaps 50 or so.

Mr. Freeman: Just to give you the flavour?

The Chairman: Exactly. We will want of course to know this also from other agencies to see whether there are great gaps here or perhaps, and I am sure this is not true in this case, whether there are duplications or undesirable duplications.

Senator Grosart: Mr. Chairman, I think we have all been impressed with another aspect of research—the importance of continuing technical audits. I would suggest that Mr. Rasminsky might be able to give us some evidence of research assessments of the validity of decisions or advice by the bank. Do you assess your own decisions?

Mr. Rasminsky: We are doing it all the time.

The Chairman: Even at night?

Mr. Rasminsky: Particularly at night.

Senator Grosart: I am not suggesting for a minute there is any more necessity to this in your decisions than in any other, but I think we are all concerned with the importance of this kind of assessment. I have

always in my own operations tried to remind people that when something goes wrong everybody tends to say, "Well, it was his fault, or his fault; it was their fault." The question I ask myself first is: "Where did I go wrong?"

Mr. Rasminsky: Yes.

Senator Grosart: And this is often the most valid research that you can do in this area of decision making.

Mr. Rasminsky: Well, there certainly is a great deal of that sort of self questioning that goes on in the Bank, and there is certainly a realization on the part of the management of the Bank that mistakes can be made and no doubt have, that monetary policy is not something where you can ever be quite sure that you are right. You certainly cannot look to the back of the book and find the answer.

Senator Grosart: I was not questioning the fact that you do this in an operational way. What I was asking was: Is it a research function?

Mr. Freeman: Could I say something on that? As a research function, one of the things you can use the model for is to go back into the period of history and say, if we had done this instead of that, what difference would it have made. How good the answers are will depend upon how realistic a model you have. That is basically what you can do with a model, to help you look into the future and say what will happen if you do this rather than that.

Senator Grosart: You say you can do it. I am asking you, do you do it and to what extent as a research function. I am not dealing with ordinary management prudence.

Mr. Rasminsky: I would say that we have not, as a continuing research function, had a steady backward look at the way we have carried out our own responsibilities. We do it in the sense that we are bound to do it periodically. We are bound to do it once a year when we report to the Minister of Finance in the annual report, because there I have to give an accounting of the way monetary policy has been conducted over the past year. It is done from time to time when I or the others of the bank have occasion to make a public speech, but if you go further than that and ask the question, is there a continuing effort on the part of the Research Department to search out systematically what the mistakes may have been then I would have to say that this is a matter that is talked about a good deal but it is not dealt with systematically in the Bank. Perhaps it should be.

Senator Grosart: I would ask one further question. We are concerned here, naturally, with the whole

function of R and D as it affects Canadian productivity as a component of GNP. Has the Bank made any study of this? Have you put this into your computer?

Mr. Freeman: No. I think that you probably will find that much work has been done on it around Ottawa would have been either at the Dominion Bureau of Statistics or the Economic Council.

Senator Grosart: I do not think either have done any significant work in that area. We are trying here in this committee to answer this question. For example, we have the broad recommendation that our total Canadian public investment in R and D is inadequate when compared with other OECD countries. This is, by and large, a top-of-the-head conclusion reached from comparing known input into R and D with the GNP of various countries.

The Chairman: Trying to relate research to long-term economic growth.

Senator Grosart: But, nobody, as far as I can find out, has attempted to say how significant R and D is as a component of national productivity. Indeed, we had the statement made, I think it was by Dr. Solandt—it was a quite definitive statement made here—that mere raw comparison of total dollars spent in R and D and GNP was quite false and invalid, but nobody has told us why it was invalid. There are people who will say, "Well, look at Japan, they do comparatively a very low percentage of R and D, but look where they are?" We can get comments of this sort, but we do not seem to have any really definitive information for Canada and I would suggest that either the Economic Council or the Bank or somebody should agree that this is just as important as wheat.

The Chairman: You would feel that this belongs more to the Economic Council as a responsible . . .

Mr. Rasminsky: They have certainly done more work on productivity, but productivity is of such basic importance in the economy that I would certainly not disclaim interest or responsibility for keeping our time and thought on it. This is really an example of one of the things you were suggesting before, Senator Grosart. Productivity is a terribly difficult concept and terribly difficult to measure and it is one respect in which our information is really the most deficient, because the data that we have on input is constructed on a different basis than the data that we have on output and you have to somehow match the two together to get even sectoral figures of productivity, to say nothing of the difficulties of the concept of productivity for the economy as a whole. I quite agree.

The Chairman: Yet, we have many speeches on productivity.

Mr. Rasminsky: And yet we naturally speak about productivity a lot because it is so vital.

Senator Grosart: As a matter of fact, in many ways it appears to be becoming perhaps the most important economic indicator of all—per capita productivity.

The Chairman: In developing your research program do you discuss this with other research agencies or do you try to develop it more or less in isolation according to your specific needs?

Mr. Rasminsky: Well, most of that part of the program which is—and this is the bulk of it—oriented towards immediate policy is in response to our own specific needs. In many of the policy things with which we are concerned, of course, there will be discussions with other government departments.

The Chairman: Of course, discussions with the DBS and with the Department of Finance.

Mr. Rasminsky: Discussions daily with the Deputy Minister of Finance. Quite frequently, our research people particularly will be in touch with the DBS, and we see a good deal of the people in the Department of Trade and Commerce and in the Department of Industry.

The Chairman: Is there some kind of agency? There is certainly no central agency, but is there some kind of interdepartmental or inter-agency consultation trying to look at our overall effort in the field of economic research and trying to see whether there are gaps, for instance, or undesirable duplications?

Mr. Rasminsky: There is no formal interdepartmental agency of the type that you refer to, that I know of. There is a good deal of contact between people in our research department and people in the Dominion Bureau of Statistics and in the Department of Finance and in other departments.

The Chairman: But you are all trying to plug in to meet your needs, without looking perhaps too often at the general picture.

Mr. Rasminsky: It may be that that has resulted in some gaps and I think that one of the valuable things that the Economic Council has done is point to the gap in information on productivity in particular, through the stress that it placed on productivity. But it is the case that there is now no attempt at co-ordination or the avoidance of duplication in the research effort of the different agencies in Ottawa. I suspect that the main problem that has arisen there is not the problem of duplication. I do not think that there is a great deal of duplication in research, because they are all doing so little, in fact, but I think that the

problem may be more serious with regard to the possible existence of gaps.

Senator Grosart: Could I add a supplementary, Mr. Chairman? We hear in corridors from time to time, we even read in speeches by economists, that there are conflicts between different groups of economic advisors. We sometimes hear that there is a conflict at times between the economists in Trade and Commerce and the economists in Finance. We even hear that each is giving different advice to Government. Sometimes, you even hear of a conflict between the Governor of the Bank of Canada and the Minister of Finance.

The Chairman: Not recently.

Senator Grosart: It disturbs me as a layman that these conflicts exist, because it seems to me that somewhere there is a responsibility of all those engaged in this area to reach a consensus. Surely, before this advice goes to the Minister of Finance—and I am concerned with the importance of the political decisions that have to be made—there is a responsibility on the various groups. That is why I asked about the possible magnitude. There is a responsibility on those groups to reach some kind of an expert consensus. If, as you say, there is no mechanism for co-ordination, is it likely that we will ever get this? I am not suggesting that all economists are ever going to agree.

Mr. Rasminsky: No.

The Chairman: I hope not.

Senator Grosart: But surely they should be able to present the Minister with a consensus, so that he is not put in the position of saying "I wonder whether the boys in Trade and Commerce are wiser than the boys in Finance, or is the Bank of Canada right, or is the Economic Council right?"

Mr. Rasminsky: I am not sure whether I agree with that, senator. You know, one can never be absolutely sure that one is right.

Senator Grosart: I agree.

Mr. Rasminsky: I am not in favour of conflict or conflicting advice to ministers for its own sake, but the minister ultimately, in dealing with the field of his own responsibility, has to take responsibility for his actions. In a situation where one cannot always be sure that one is right, it may be that it is a good thing for the minister to hear all sides of the question and be left in the position where he has to make up his own mind and where he is not confronted with a solid phalanx or official opinion that he would have to go against.

There are some situations where one can be pretty sure that one is right. In those situations, I suspect

that through the sort of informal contact that there is in a small place like Ottawa, between senior officials of different departments and agencies, in those situations I think that a consensus does form and that the different ministers tend to get the same sort of general views expressed by their own officials or the different officials that talk to the same minister.

But in other cases, I am not sure that it would be such a good idea to have a machinery which obliged people to come to a consensus of view to confront ministers with.

The Chairman: If this was a requirement, on certain occasions ministers would not receive any advice.

Senator Yuzyk: Because they would be told what to do.

The Chairman: So he would not do anything.

Mr. Rasminsky: You are taking a very optimistic view of it.

Senator Grosart: This is a problem that comes up continually in the whole field of science. An essential problem is that the ultimate decision-maker, whether in the field of fiscal or monetary policy or in the field of science policy, is a layman. Personally, I do not understand the validity of a mechanism by which a layman is required, in the final analysis, to stake his whole future on his ability to choose between experts' advice.

Mr. Rasminsky: But there is a great difference, senator, between the positive sciences, physical sciences or life sciences that you have been concerned with up to now, and economics. In the experimental sciences, where you are dealing with minute quantities of inanimate objects, you can put them into a test tube and you can observe the results, while that is not the case with the human sciences. There are too many unknowns for you to be absolutely sure that you ever have the right answer. So I do not think it is a question of there being a right answer to the problems of economic and fiscal financial policy that ministers and central bankers are confronted with if only we have the wit to determine it. I think we must clearly eliminate as many of the uncertainties as we can, that is what we try to do through our research effort.

As I said before, the elimination of those uncertainties depends upon the relationships among the variables remaining the same in the future as they were in the past. We have to get as close to that sort of predictability as we can, but we are a long way from it still. So that I do not think really it is a question of knocking together the heads of the people who are concerned with this, forcing them to come up with the right answer and then telling the minister what the right answer is. I do not think we can be that sure.

Senator Grosart: That was not my suggestion. My suggestion was that there was a responsibility, or there might be a responsibility, on those officials to achieve this. I was not suggesting that they be forced by statute or regulation, or in any other way, to reach a consensus. I put the proposition to you that there might be, let us say, a larger degree of group responsibility assumed from time to time in this area.

The Chairman: Unfortunately at the end you are left with a democratic process though and you must find people who will accept the position of minister and make up their own minds on some occasions.

Senator Grosart: But surely what we are all trying to do is to improve the efficiency of the democratic process, and surely the main tool is research. I cannot accept the proposition that we have to say the democratic process must be increasingly inefficient as against other forms of government. My own view is that the tremendous strides forward of science and technology should, of all things, be harnessed to improve the efficiency of our democratic process.

The Chairman: I have to give a lecture in a few moments, but before going I should like to ask a question on forecasting. Are you doing a lot of work in this field? I mean mainly in the field of the short-term forecasting?

Mr. Rasminsky: We try to form judgments on what future developments of the economy will be.

The Chairman: You do this independently of the Department of Finance?

Mr. Freeman: We do it with quite close consultation; the experts talk to each other, and it is a very continuous process in both shops, people putting in new imports of information which change their forward views of how things might work out for the next few quarters.

The Chairman: If I remember aright, I think the Economic Council has proposed that there should be some kind of specialized institute to do this.

Mr. Rasminsky: Yes, I think they have.

The Chairman: There has been no action taken on this recommendation that I know of.

Mr. Rasminsky: I do not know whether the action was taken specifically on this recommendation, but I believe that some months ago the Government arranged for Ronald Ritchie to make recommendations on the possible establishment of some kind of research centre. Whether it was related to this or related to the idea of the international development centre I am not sure. This is the only thing I know of.

The Chairman: I do not think it is related to that case.

Senator Yuzyk: I have one more question. In your recommendations on page 8 you state:

A great deal of standardization of accounting concepts, methods of record keeping and computer programs will be necessary.

All that, of course, means it will be necessary to find some kind of co-operation between various agencies.

Mr. Rasminsky: That is right.

Senator Yuzyk: My question is: has there been any progress made in this direction so far, and what body would you suggest would have to undertake the attempt at standardization?

Mr. Freeman: Well, it depends on the stage at which one is thinking of this. We were really looking a fair distance ahead, thinking, for example, of the financial information supplied by various kinds of financial institutions. Obviously, you want to collect the information, if you are collecting it from the chartered banks, for example, on common definitions, because, if you do not, you run into a terrible lot of trouble.

The problems go much beyond that and are much broader because, generally, you want to look at the data you have got on the financial operations of the banks in conjunction with the data on the operations of other financial institutions. Obviously, therefore, you are going to have a problem of this kind.

The Bureau of Statistics faces this problem itself all the time in attempting to collect data, but it becomes increasingly important in our society the more we move toward automating the whole process from record-keeping on up. If you start with an automated system of keeping your records, which will not generate the information in the way in which it is needed by the collection agencies, then you are in a terrible problem.

Senator Yuzyk: This is what I am getting at. Does this mean that universities, in other words, would have to start teaching a new system of record-keeping that would be more or less standard for Canada in particular or, say, standard for North America. Is this necessary?

Dr. Post: This is thinking more in a long-term sense of development by the professional accounting associations or by groups of computer users or things of that sort, perhaps with the initiative of the Dominion Bureau of Statistics. Recently the Dominion Bureau of Statistics has been taking a lot of initiative with respect to municipal Governments and has done a lot of work there, putting forth a lot of effort to have common systems of accounts adopted

by municipalities, first of all, by going to provinces, to the Departments of Municipal Affairs, and then hoping that this can be adopted quite generally. Most of these initiatives would have to come either from the professional associations or from the government.

Senator Yuzyk: Then there has been progress made with the Dominion Bureau of Statistics taking the initiative?

Dr. Post: Certainly.

Senator Yuzyk: Would you suggest some other agency to accelerate that?

Dr. Post: I think that we are really raising the question of whether there should be a group comparable to the Canadian Standards Association which would concern itself with problems of standardization in bookkeeping or in the interchange of electronic data.

Senator Yuzyk: I would gather that not all computers are the same. Nor do they have the same systems.

Dr. Post: No.

Senator Yuzyk: Therefore, this might require some form of standardization as well.

Dr. Post: We hinted that there may be need for that as well. I do not know this as a fact, but I suspect that the government is one of the largest buyers of computer hardware in the whole country, and would be perhaps in a position to take some initiative in that area.

Senator Yuzyk: This is what is suggested here in a general way.

The Chairman: You can see that we are still in quite a confused state of mind in embarking into this new operation, but we may be able to learn a little bit more as we go along. As we see the other agencies, mainly involved in economic research, we may want at a later stage, if we are not imposing upon you, to see you again.

Mr. Rasminsky: Any time you say, sir, I will be very pleased to come back again whenever it is convenient for you.

The Chairman: Whenever it is convenient for you and for us. In the meantime, thank you very much indeed.

Committee adjourned.

APPENDIX 24

BANK OF CANADA

BRIEF TO THE SPECIAL COMMITTEE
OF THE SENATE ON SCIENCE POLICY1. Summary and Recommendations

(a) In recent years the Bank of Canada has greatly expanded its internal programme of economic and financial research, introducing computer-based methods of storing and analyzing data on a large scale and up-grading the skills of its research staff both through further post-graduate study and on-the-job training in the use of modern analytical techniques.

(b) The staff of the Bank's Research Department is encouraged to participate both in specialized analytical work bearing on current policy problems and in basic research into underlying economic and financial processes.

(c) The Bank has recently undertaken the initial construction and continuing development of an experimental econometric model of the Canadian economy which, it is hoped, will become increasingly useful over time as a research tool for studying the implications of alternative courses of action in the area of public financial policy.

(d) An important by-product of these efforts has been the development at the Bank of an advanced infrastructure for the support of large-scale empirical investigation in economics - a first-class computer service backed by trained scientific programmers and data operators, a readily accessible data file in machine-readable form containing most commonly-used economic time series, and a versatile library of statistical programmes for analyzing economic data available at all times on the computer.

(e) Due to the economies of scale in collecting, compiling and analyzing data inherent in modern computer technology, it seems possible that economists are now on the threshold of a major breakthrough in the ease and speed of empirical research. If these opportunities are to be realized in practice, however, there is some urgency in the Government (perhaps through the Dominion Bureau of Statistics) showing the way by developing, and encouraging

the sharing of, common nation-wide economic information and research facilities based on the computer.

(f) In this connection, the Bank is actively studying possible arrangements under which it might make generally available to research groups at universities and elsewhere direct access to its computer file of non-confidential data and related computer programmes.

2. Functions and Organization of the Bank

The Bank of Canada was established by Act of Parliament in 1934 as Canada's central bank. The Bank's primary responsibility is for the conduct of monetary policy. It acts as agent for the Government of Canada in the management and servicing of the public debt and in foreign exchange operations. It serves also as a source of information and advice to the Government on economic and financial matters. In addition to its Head Office in Ottawa the Bank has eight other agencies across the country whose functions relate mainly to the servicing of the public debt and the distribution of currency. The Bank has approximately 1,050 employees excluding its building maintenance staff.

3. Research Activities of the Bank

Since its inception, the Bank has devoted resources to internal research activities of an applied character related to its operating responsibilities - the gathering, recording and analysis of economic and financial information helpful to the management of the Bank in its consideration of current policy questions. In recent years, increasing effort has been directed toward the study of basic economic and financial processes, employing econometric research techniques where appropriate. This programme has involved the introduction of computer-based methods of storing and analyzing economic and financial data on a large scale. It has also involved efforts to develop the skills of the Bank's research personnel both in terms of formal academic preparation and of on-the-job training in the use of advanced quantitative techniques of economic analysis.

4. The Bank's increasing investment in research is based on the view that society has much to gain from efforts to improve public economic policy, since as is widely recognized, the costs to society of misdirected policies can

be heavy. It is our hope that a description of the Bank's efforts to conduct both applied and basic research into economic questions will be helpful to the Committee in its enquiries concerning research in the social sciences generally in Canada. In addition to describing and commenting on the Bank's own research efforts and experience, this brief will make some observations concerning the impact of modern computer technology on the organization and methods of research in economics.

5. The research activities conducted within the Bank are centered primarily in the Research Department, although an increasing amount of applied research is also carried on in departments with operational responsibilities - notably in the Securities Department (which conducts transactions in the market for Government securities, handles the flotation of new Government bond issues, etc.) and in the Foreign Exchange Department. There is also a small unit which does technical and market research studies for the Industrial Development Bank, a wholly-owned subsidiary of the Bank of Canada. Because the research activities of these other departments tend to be of a specialized character directly linked to current operational needs, the following account will concentrate on the organization and activities of the Research Department.

6. The Research Department

The permanent staff of the Research Department currently numbers about 120 compared with 72 at the beginning of 1962. Of the present staff, about 42, who hold university degrees in economics, are engaged in economic analysis on a full-time basis. Of these, 20 have pursued post-graduate studies beyond the Bachelors level and an additional 14 beyond the Masters level. In addition to those engaged in economic analysis as such, there are about 13 other university-trained employees in the Department, chiefly in the library, the computer programming section and the information section. All members of the Department are employed at the Bank's head office in Ottawa, although the duties of a number of the professional staff involve a considerable amount of travel both within Canada and abroad.

7. The organization of the Research Department reflects what are conceived to be its main objectives and the best means of achieving them. (An organization diagram is attached.) It might be mentioned at the outset that many of the Department's professional staff are quite recent university graduates and that one of the Department's functions is to serve as a training ground in policy-oriented economic analysis at the applied level. It is useful in the training of economists to have the opportunity to observe at first hand, in a working relationship, the problems and decision-making processes of departments and agencies with operational responsibilities in the field of public economic policy. The Research Department does not hesitate to employ professional staff on a temporary basis where this is preferred by the employee; such people are useful to the Bank during their period of service and their experience in the Bank may be useful to the country when they leave to take positions elsewhere in the public service, in the universities or in business.

8. The organization of the Research Department is essentially a horizontal structure, consisting of relatively small groups of university-trained people assigned to specific subject-matter areas. The objective here is two-fold: to give the personnel of each section the maximum amount of direct communication with the members of the senior management of the Bank whose needs they are trying to serve, and to define clearly for each group the subject-matter area in which they are expected to develop special expertise.

9. The current reporting and analysis functions of the Department are parcelled out by subject-matter area as follows: the economic situation and outlook in Canada; financial conditions in Canada; the economic and financial behaviour of particular sectors of the Canadian economy - business enterprises, households, the various levels of government, financial institutions, and transactions with non-residents; the U.S. economic situation; economic conditions overseas and international financial affairs. Specialists in each of these areas provide the management with information, analysis and forward-looking appraisals relevant to current policy questions, both on request and on their own initiative. The bulk of the data they use is compiled and published by the Dominion Bureau of Statistics or by official sources abroad, but the Department also has

responsibilities of its own for collecting and compiling data concerning banking and financial markets in Canada, much of which is published in the Bank's monthly Statistical Summary and in its Weekly Financial Statistics. The Bank publishes an analysis of recent economic and financial developments in the Governor's Annual Report to the Minister of Finance.

10. Basic Research in the Department

The Department's programme of basic research is organized rather differently. The Department has a small central group of permanent staff members who are employed on a full-time basis in directing and co-ordinating research activity of this type, which uses contemporary methods of quantitative empirical analysis. This programme has been developed within the Department during the past three years and is centered around the attempt to construct an experimental quarterly econometric model summarizing in a system of simultaneous equations the main relationships and mechanisms of the Canadian economy. Models of this kind are potentially useful tools for economic analysis for the following reasons:

- (a) They attempt to summarize in a precise way and within a consistent economy-wide framework the main forces and mechanisms which are thought to depict economic behaviour, explicitly recognizing the interdependence of the various parts of the economic and financial system.
- (b) They provide a framework for investigating the plausibility of alternative theories about economic behaviour as measured by the extent to which they seem able to account for the actual performance of the economy in the past.
- (c) To the extent that success is achieved under heading (b), they provide a plausible basis for trying to estimate the probable magnitude and time-path of impact of public policy actions on the behaviour of the economy.
- (d) As an extension of (c), they may be of help in attempts to predict more reliably the future course of economic activity.

11. In the development of this programme, the Research Department has enlisted the skills of a number of academic consultants and summer students on a temporary or part-time basis - generally Canadians with recent training in first-rate graduate schools. Broad areas of the economy within which to conduct research have been assigned to teams of three or four analysts each, generally under the direction of a university professor with advanced training in contemporary methods of econometric analysis and considerable experience in applied research. To the maximum extent possible, these research teams have included (on a full or part-time basis) members of the Department's permanent staff with a specialized knowledge of the institutional behaviour and the data sources in their areas of subject-matter specialization. This way of organizing research teams reflects the view that good research depends upon a fertile interaction of advanced methodology and solid information. The work these teams were asked to do was:

- (a) to develop and supply the central group with a set of equations describing aggregate economic behaviour in their area of the model, and
- (b) to conduct such partial or disaggregated studies in their area of the model as seemed most promising in terms of useful results, considering data and other limitations.

12. The result of this work is that the Research Department has in fact developed an initial version of a large-scale experimental quarterly model of the Canadian economy which it hopes to make available in the near future to economists in the public service, the universities and elsewhere as a research tool. It goes without saying that this prototype version of the model is deficient in numerous important respects and represents a very early stage in what is bound to be a long process of development. Major improvements will have to be made over a period of years before the model is likely to provide a sufficiently realistic portrayal of the main economic and financial processes of the Canadian economy to be of important help in policy analysis. In addition to the model as such, the research programme has also generated a number of studies of particular aspects of the model which will appear shortly either

as articles in economic journals or in the Bank's forthcoming series of Staff Research Papers.

13. An important by-product of the Research Department's efforts in the field of basic research has been the development of the necessary infrastructure to support large-scale empirical investigation in economics in Canada. Prior to the advent of the computer, economic research tended to be a solo enterprise in which nothing beyond the simplest types of computations could be attempted owing to the vast clerical resources required for sophisticated analysis of data. As in the physical sciences, the computer has changed all this, enormously extending the feasible range of analysis and routines to support such analysis at the disposal of research economists, and making possible very substantial economies of scale through team research supported by well-organized pools of data and programming expertise. Econometric models of the sort described require the largest of modern computer facilities, placing heavy demands upon core memory and speed. In the first year or two of its econometric programme the Department used a number of computer service bureaus where large scale machines were available. Later on a remote terminal was installed in the Department that provided direct access via telephone circuits to Univac 1108 computers, first at the University of Utah, then at Ontario Hydro in Toronto, and currently at a commercial facility in Ottawa. With this facility, a library of general purpose statistical programmes, and a large data file accessible through the computer, Research Department personnel can submit jobs several times a day and have their results back typically within five minutes. At a later stage the computer work of the Department will be transferred to the Bank's own computer which it is acquiring primarily for data-processing operations in its Public Debt Division.

14. The overhead expenditure involved in the original development of these databank facilities and programmes was shared by the Economic Council and the National Energy Board. Since it began operating, the system has drastically lowered the marginal cost of routine statistical manipulations. The master data file now in use has about 5,000 economic and financial time series which have been classified, indexed and verified to their original sources and

are stored on magnetic tape. The combination of first-class computer service, a data bank with most commonly used economic time-series readily accessible, and a library of statistical programmes available at all times on the computer has greatly increased the volume of experimental work which the research staff can complete within a given time period. The use of the Bank's computer facility is not limited to econometric equation fitting or model simulations; it is finding increasing use as a routine clerical tool for analysis and forecasting. Computer storage costs may already have declined sufficiently to make it worthwhile to have almost all of the Department's data files in a machine-readable form. If computer costs continue to decline, a situation can be envisaged within a very few years when computer terminals will be as common as adding machines and most statistical operations will be directed to computers. This technological trend has important implications for the collection and publication of data as well as for the training of economists and statisticians. It also holds out the possibility of a major breakthrough in the ease and speed of empirical research in economics.

15. Recommendations

The computer has drastically lowered the marginal cost of analyzing data once it has been compiled, and it may well have an even more dramatic impact in reducing the cost of collecting and compiling basic economic information. Given greatly increased power to analyze masses of data and a greatly increased volume of economic data being generated, there remain difficult problems to be overcome if the potential economies of scale which the computer revolution is making technically feasible in the area of economic statistics and analysis are to be realized in practice. A great deal of standardization of accounting concepts, methods of record keeping and computer programmes will be necessary, and computers themselves may require more standardization than exists at present. Increasingly, basic data and the computer programmes for manipulating them will have to be consolidated in large databanks and made accessible on a shared basis to all users. The federal government many years ago established the Dominion Bureau of Statistics as a centralized statistical agency and the economic return from that investment, if it could be measured, would be very great. The time would now seem to have arrived to carry the

development of the nation's information systems further by undertaking (perhaps through the Bureau of Statistics) new initiatives to ensure that Canadians will in fact be able to benefit from the greatly improved access to economic and other information which the computer puts technically within our grasp.

16. Some of the steps which might be taken would yield results only over a long period. There are other steps which could bring quick returns. All of the data currently published by the Bureau of Statistics in printed form could also be made available on a machine-readable file which would be accessible through remote terminals to research establishments anywhere in the country. For this, the computer hardware and the software already exist. The Bureau is already working on a pilot project of this sort. It would seem logical that computer programmes, the essential tools for extracting and analyzing the information content of primary data, should also pass freely along such a network. The overhead costs involved in the development of statistical routines and programmes for the maintenance and manipulation of large-scale computer files of economic data are substantial, and it would be of great practical advantage to economic research in Canada if such programmes and files of non-confidential data could be made the common property of the research community at large with ease of access at minimum cost. Sharing of data and programmes would greatly facilitate communication within the research community and the organization of joint research programmes. There would seem to be some urgency in this matter. If the economies of scale possible through system-sharing are not pursued urgently they may be lost through the proliferation - at enormous overhead costs - of overlapping and incompatible data files and programmes at a number of separate research centres across the country, each trying to develop large-scale facilities of its own. Means should also be studied of reducing the existing degree of incompatibility among the various types of computer hardware and communications links offered by competing suppliers, since this creates much difficulty and expense for users who want the advantages of system-sharing.

17. The Research Department has received numerous enquiries from research groups inside and outside the universities both in Canada and abroad, asking whether and on what terms it would be possible to have access to the

Bank's computer file of non-confidential data and the associated computer programmes. The Bank would like to be able to meet these requests and is actively studying possible arrangements under which it might make such data and programmes available to outside groups at minimum cost on a non-profit basis. If suitable arrangements can be worked out, access to the Bank's systems - including direct access through remote terminals to the appropriate computer files - will clearly provide a major impetus to economic research at universities and other centres across the country. It may also serve to hasten the development under public auspices of more broadly based information and systems networks of this kind, in which the Bank would become merely one among many contributors of data and programmes.

18. It should be a matter of public concern that the universities and other research establishments have access to good research facilities for training people in the application of scientific methods to the study of economic and other social problems. The universities will increasingly be called upon to offer courses directed to research personnel who graduated a few years ago but who lack training in the rapidly advancing area of computer technology. With skilled scientific programmers a very scarce resource at present, research economists have been forced to divert a considerable part of their energies to learning about the technicalities of computers and programming languages - skills which ought increasingly to be part of the regular training of university students in economics and statistics. In seeking to advance the training and skills of its own research staff, the Bank has found it very helpful to have university professors thoroughly familiar with contemporary research techniques working in the Research Department as consultants; because of the value it places on the maximum of direct contact between such outside specialists and its own research staff, the Bank has ceased to use the alternative approach of commissioning research projects to be done by consultants working entirely outside the Bank. In addition, several employees of the Research Department have returned to university to supplement their earlier formal training. The Bank has a policy of subsidizing further post-graduate training for research personnel in appropriate cases on the understanding that the employee will return to the Bank on completion of his studies. In the current academic year there are five employees on educational leave under this programme.

October 1968.

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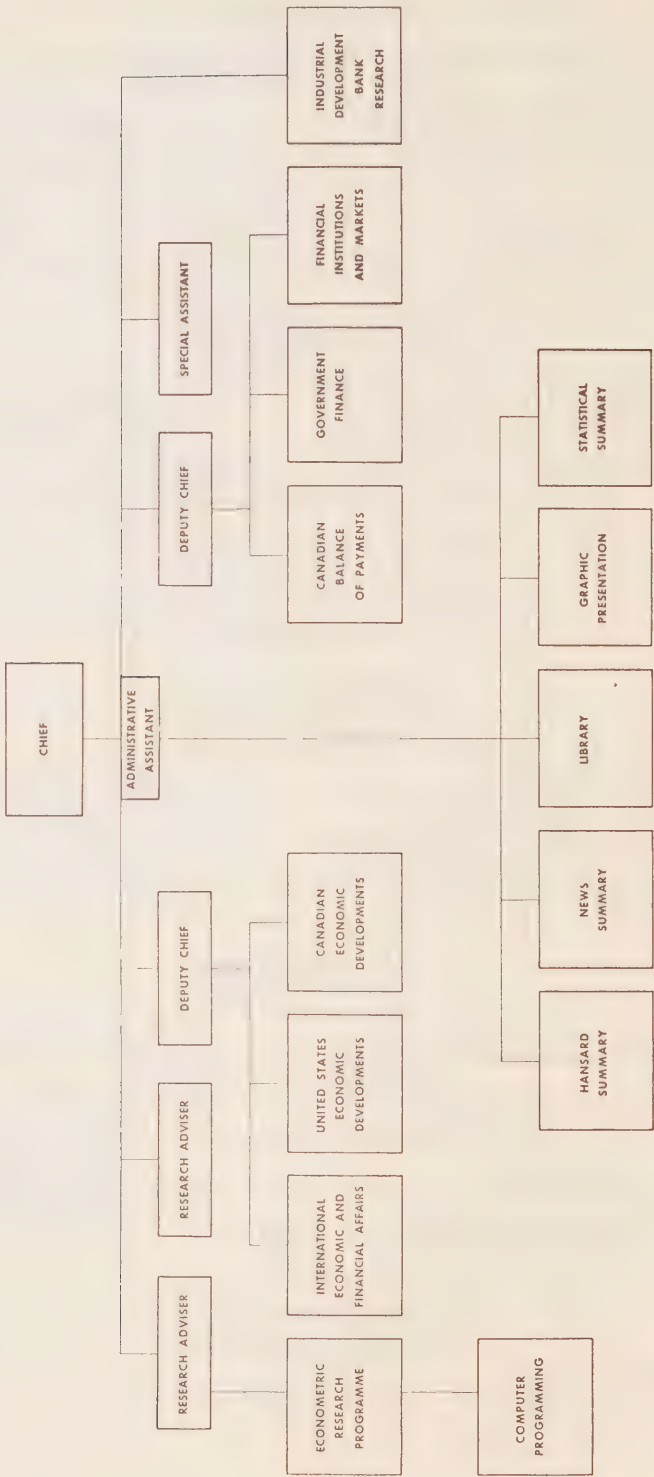
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BANK OF CANADA

APPENDIX TO BRIEF TO THE SPECIAL COMMITTEE
OF THE SENATE ON SCIENCE POLICY

This note provides supplementary information required by the Committee which was not covered adequately in the Bank's brief of October, 1968.

The research activities of the Bank are closely integrated with its policy-making and operating responsibilities, and it would be virtually impossible to define and measure "research work" as a separate function distinct from the other operations carried on in various areas of the Bank. We can, however, offer the following additional information about the Research Department as such, in accordance with the Committee's "guideline" for preparing briefs.

Personnel Policies

As mentioned in the brief, the Department has a large proportion of recent university graduates on its staff. In recent years there has been an increasing effort to recruit economics graduates with specialized training beyond the Bachelor's level. Since only a small number of professional personnel are hired each year -- typically fewer than 10 people -- it has continued to be feasible for the task of interviewing and selection to be the responsibility of the Chief of the Department, assisted by senior departmental officers.

The Department relies mainly on its numerous direct contacts with university professors of economics and business to refer graduating students at the B.A. and M.A. levels to the Bank. Recruiting teams from the Bank also visit a number of universities each year and refer suitable candidates for research positions to the Research Department. At the Ph.D. level the Department obtains the names of graduating students in economics at Canadian and foreign universities and contacts them directly. All candidates being considered for professional positions are invited to visit the Department to be interviewed.

The basis for hiring professional staff is mainly academic performance and recommendations, related work experience, and subjective impressions formed in interviews. At the more junior levels the more important qualities sought, besides native intelligence, include motivation and skill in communication. At the senior levels, demonstrated ability in the field of applied economic analysis is also required.

The Department is small enough that the selection of supervisory and administrative staff is quite infrequent and informal. Most of the senior people in the Department have supervisory and administrative responsibilities, but only about six of the officers devote the bulk of their time to administration, since most of this work within the Bank is carried out by the Secretary's Department. In general, the ability to supervise the work of others and the willingness to accept some administrative responsibilities are associated with advancement in the Department.

The education programme in the Department consists of support for courses taken in Ottawa, as well as educational leave. The Department itself has organized courses within the Bank on research techniques, computer methods and programming. Seminars on research topics are held from time to time. A number of staff members have taken courses at local universities on a part-time basis and by correspondence. The Bank encourages these efforts of staff members through financial assistance with fees and by arranging time off as necessary.

Full-time educational leave with financial support is granted to staff members in certain cases where further post-graduate training is considered likely to contribute substantially to their performance of their professional duties. At present there are five people on educational leave; four who previously held Masters' degrees and one who held a Bachelor's degree.

Personnel StatisticsResearch Department Personnel (Dec. 31, 1968)

Officers of the Department	15
Economic Analysts	30
Library, Charting and Other Services	31
Computer Programmers	5
Clerical Staff	31
Stenographic Staff	<u>7</u>
Total	119
Research Consultants (part-time)	<u>3</u>

Classification of Professional Staff(a) At the Bachelor's Level:

<u>Country of:</u>	<u>Birth</u>	<u>Secondary Education</u>	<u>University Education</u>
Canada	20	21	23
U.K.	2	1	1
France	1	1	-
Belgium	1	1	1
Germany	1	1	-
	<u>25</u>		

Mean number of years since university graduation: 12.4

Mean number of years with the Bank: 8.7

Average age: 36

Per cent effective in both official languages: 30%

(b) At the Master's Level:

<u>Country of:</u>	<u>Birth</u>	<u>Education</u>		
		<u>Secondary</u>	<u>Bachelor's Degree</u>	<u>Master's Degree</u>
Canada	17	20	23	23
U.K.	3	3	1	-
U.S.A.	1	-	-	2
West Indies	2	1	-	-
India	1	1	1	-
Egypt	1	-	-	-
	<u>25</u>			

Mean number of years since Master's degree granted: 5.7

Mean number of years with the Bank: 5.4

Average age: 31

Per cent effective in both official languages: 35%

(c) At the Ph.D. level:

<u>Country of:</u>	<u>Birth</u>	<u>Education</u>		
		<u>Secondary</u>	<u>Undergraduate</u>	<u>Doctorate</u>
Canada	5	5	5	1
U.S.A.	-	-	-	4

Mean number of years since Ph.D. granted: 4.7

Mean number of years at the Bank: 3.0

Average age: 32

Per cent effective in both official languages: 100%

Special Committee

Distribution of the Professional Staff by Degrees
1962-1968 at Year-End

	<u>Bachelors</u>	<u>Masters</u>	<u>Ph. D.</u>	<u>Total</u>
1962	21	8	3	32
1963	21	11	4	36
1964	22	13	4	39
1965	19	14	4	37
1966	23	20	2	45
1967	27	21	6	54
1968	25	25	5	55

Previous Experience of Present Staff
Dec. 31, 1968

<u>with:</u>	<u>Per Cent</u>
Industry	36
University teaching	18
Provincial governments	2
Other federal agencies	<u>14</u>
Total	<u>70</u>

Number of Summer Students Employed
1962 to 1968

1962	1
1963	4
1964	6
1965	9
1966	4
1967	5
1968	5

Research Department Expenditures

Because the Department is closely linked to the other Head Office activities of the Bank no effort is made to allocate the expenses for space, telephones, library, office equipment and supplies. Total expenses of the Bank are published in the Governor's Annual Report to the Minister of Finance. It is possible to calculate approximately the Department's wage and salary expenditures and to estimate the amounts spent for computer services.

Main Research Department Expenditures
(in thousands of dollars)

	<u>Staff Remuneration*</u>	<u>Computer Service</u>	<u>Library Acquisitions</u>	<u>Travel</u>
1962	456.5	-	12.0	19.2
1963	509.1	-	13.5	15.3
1964	570.8	-	14.8	23.5
1965	626.1	16.0	15.0	15.1
1966	742.3	33.0	17.0	14.9
1967	953.3	97.0	19.2	18.8
1968	981.4	216.0	17.3	19.2

* Including fees paid to Research Consultants.

Industrial Development Bank

The Industrial Research Division of the Industrial Development Bank is associated with the Research Department of the Bank of Canada. This Division is located in Ottawa and shares certain of the Research Department's facilities, notably the library. This Division operates with up to three or four professional research workers and one stenographer.

The work of this Division consists of compiling technical and market information and writing reports to aid in the assessment of specific applications for credit at one or other of the 34 branches of the IDB across the country. The reports are based on information from government, industry and regional¹ sources. In recent fiscal years the average number of reports prepared annually in response to branch requests has been about 300.

January, 1969.



First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA
PROCEEDINGS
OF THE
SPECIAL COMMITTEE
ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

The Honourable DONALD CAMERON, *Vice-Chairman*

No. 24

WEDNESDAY, FEBRUARY 5th, 1969

WITNESSES:

Dominion Bureau of Statistics: Walter E. Duffett, Dominion Statistician; Dr. Simon A. Goldberg, Assistant Dominion Statistician; Dr. Ivan P. Fellegi, Director, Sampling and Research Staff; J. G. Leclerc, Director, Business Finance Division; Dr. T. J. Vander Noot, Associate Director-General, Operations and Systems Development Branch; and Humphrey Stead, Chief, Scientific Activities Surveys Section, Business Finance Division.

APPENDIX:

25. Brief submitted by the Dominion Bureau of Statistics.

The Queen's Printer, Ottawa, 1969

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Hays	O'Leary (<i>Carleton</i>)
Belisle	Kinnear	Phillips (<i>Prince</i>)
Bourget	Lamontagne	Robichaud
Cameron	Lang	Sullivan
Desruisseaux	Leonard	Thompson
Grosart	MacKenzie	Yuzyk

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday September 17th, 1968:

“The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinneer, Lamontagne, Lang, Leonard, MacKenzie, O’Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the Affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

Wednesday, February 5th, 1969

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Cameron, Grosart, Kinnear, Lang, Leonard, Robichaud, Sullivan, Thompson and Yuzyk — 10.

Present but not of the Committee: The Honourable Senator Haig — 1.

In attendance:

Philip J. Pocock, Director of Research
(*Physical Science*)

The following witnesses were heard:

DOMINION BUREAU OF STATISTICS

Walter E. Duffett, Dominion Statistician;
Dr. Simon A. Goldberg, Assistant Dominion Statistician;
Dr. Ivan P. Fellegi, Director, Sampling and Research Staff;
J. G. Leclerc, Director, Business Finance Division;
Dr. T. J. Vander Noot, Associate Director-General, Operations and Systems Development Branch; and
Humphrey Stead, Chief, Scientific Activities Surveys Section, Business Finance Division.

(*A curriculum vitae of each witness follows these Minutes*).

The following is printed as Appendix No. 25.

Brief submitted by the Dominion Bureau of Statistics.

At 5.30 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Duffett, Walter E. was appointed to the position of Dominion Statistician on January 1, 1957, on the retirement of the previous incumbent, Mr. Herbert Marshall. His immediately preceding post was with the Department of Labour. Mr. Duffett graduated in Economics from the University of Toronto in 1933 and continued his studies at the London School of Economics where he obtained an M.Sc. degree. He returned to Canada in 1935 and joined the Investment Department of the Sun Life Assurance Company in Montreal, where he was concerned with economic and financial studies of a variety of foreign countries and with substantial investment operations in these countries. From 1942-44 he served in the Economics Branch of the Wartime Prices and Trade Board in Ottawa, a government agency responsible for civilian supply and price control. He was assistant to the officer in charge of development of statistical series required for wartime civilian supply administration and also participated in policy development in these fields. Subsequently, he was involved in the gradual dismantling of the wartime price controls. In 1944 he joined the Research Department of the Bank of Canada, the Canadian Central Bank, and in due course became Assistant Chief of the Department. He participated in the development of the conceptual structure underlying the first set of comprehensive national accounts for Canada, later published by the Dominion Bureau of Statistics. His main duties related to economic and financial studies of developments in Canada and the United States. In 1955 Mr. Duffett was appointed Director of the Economics and Research Branch of the Department of Labour, where he was in charge of studies of employment conditions, wage rates and industrial relations. As Dominion Statistician he is in charge of the Dominion Bureau of Statistics, which, as the central statistical agency of Canada, has a staff of some 3,000 persons and covers the full range of economic and social statistics, including education, health, welfare and so on. It also produces such national aggregates as input-output tables, balance of payments, and the national accounts. Mr. Duffett is a member of the International Statistical Institute, Inter-American Statistical Institute, is a Fellow of the American Statistical Association and served as Canadian Delegate to the United Nations Statistical Commission in 1958, 1962, 1965, 1966 and 1967.

Goldberg, Simon A. graduated in Economics and Political Science in 1939 from McGill University where he also received his M.A. degree in Economics. He continued his studies in Economics at Harvard University where he obtained his A.M. and Ph.D. degrees. After service with the Royal Canadian Air Force from 1942 to 1945 he joined the Dominion Bureau of Statistics as National Income Statistician and became a leading member of a small group that developed and constructed Canada's National Income and Expenditure Accounts. In 1950 he was appointed Director of the Bureau's Research and Development Division, which, in addition to the National Accounts, was responsible for development and publication of input-output studies, estimates of the distribution of income by size, indexes of production and productivity, and a variety of other statistical

studies. In 1954 Dr. Goldberg was appointed Assistant Dominion Statistician for statistical integration and development. In this capacity he has been responsible for the evolution of a progressively integrated and improved Bureau-wide system of social and economic statistics and overall research and development. Dr. Goldberg is a member of the International Statistical Institute, the Inter-American Statistical Institute, the International Association for Research in Income and Wealth (member of the Executive Council), is a Fellow of the American Statistical Association and has served as alternate Canadian delegate to the United Nations Statistical Commission. He is the author of a variety of published papers and studies.

Fellegi, Ivan P. joined the Dominion Bureau of Statistics in 1957 and concurrently enrolled at Carleton University in Ottawa where he obtained his M.Sc. degree in 1958 and a Ph.D. degree in 1961. Dr. Fellegi was given increasing responsibilities until he became Director of the Sampling and Survey Research Staff in 1962, the position he occupies at the moment. In addition he acts as the Senior Mathematical Advisor of the Bureau. He was elected a Fellow of the American Statistical Association, Fellow of the American Association for the Advancement of Science, Member of the International Statistical Institute. He serves presently as an Associate Editor of the Journal of the American Statistical Association handling the papers on sampling, survey methods, sociology and demography. He is the author of a variety of published papers and studies.

Leclerc, Guy was educated in Quebec City. He received a Bachelor of Commerce degree in 1953 and did some post-graduate work in 1954 at Université Laval. He spent three years in the financial business and in 1957 he joined the Business Finance Division. Since then he has held successively, and sometimes concurrently, the position of chief of several of the Sections of this Division. In 1965 he became Assistant-Director of the Division and in 1966 he was appointed Director, a position he is still holding at the moment. In 1968 he was elected to membership in the International Association for Research in Income and Wealth.

Vander Noot, T. J. was educated in the United States where he received a B.A. degree in 1952 at Duke University. He received his M.A. degree from the University of Minnesota in 1954 and a Ph.D. from the same university in 1965. After completing his course-work, Dr. Vander Noot joined the Research Department of the Federal Reserve Bank of Minneapolis in 1956 and became Department Head in 1960. In 1964 he went to the Board of Governors of the Federal Reserve System as Chief Analyst, responsible for the design and implementation of new statistical reporting systems. In 1967 Dr. Vander Noot joined the staff of the Economic Council of Canada and also became an advisor to the Dominion Bureau of Statistics. His main responsibility was the design and implementation of an information system for economic data for the Government of Canada. Upon completing the design and implementation of the Canadian Socio-Economic Information Management System (CANSIM), Dr. Vander Noot joined the staff

of the Dominion Bureau of Statistics as the Associate Director-General of Operations and Systems Development Branch in late 1968.

Stead, Humphrey graduated from Cowichan High School, British Columbia, in 1954 and attended Collège Militaire Royal de St-Jean from 1954 to 1957. He received a B.A. from the Royal Military College of Canada in 1959, then served for three years in the First Battalion, Royal 22^e Régiment. Mr. Stead returned to university after leaving the Army and graduated in 1963 from the University of British Columbia with a B. Com. He joined the Dominion Bureau of Statistics in June, 1963 and began working in the field of R & D statistics. Mr. Stead attended the Université Catholique de Louvain in 1964-65 on a Belgian Government scholarship and returned to the D.B.S. in July 1965. He worked at the Directorate for Scientific Affairs of the OECD in Paris during the winter of 1968. Mr. Stead is at present chief of the Scientific Activities Surveys Section, Business Finance Division.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Wednesday, February 5, 1969

The Special Committee of the Senate on Science Policy met this day at 10.00 a.m.

Senator Maurice Lamontagne (*Chairman*) in the chair.

The Chairman: Honourable senators, we are meeting this morning the representatives of the Dominion Bureau of Statistics, including the Dominion Statistician, Mr. Walter E. Duffett, and, on my left, Dr. Simon A. Goldberg, the Assistant Dominion Statistician, Dr. Ivan P. Fellegi, Director, Sampling and Survey Research Staff, Dr. T. J. Vander Noot, Associate Director General, Operations and Systems Branch, Mr. J. G. Leclerc, Director, Business Finance Division, and Mr. H. Stead, Chief, Scientific Activities Surveys Sections.

Without any further introduction, I would like Mr. Duffett, the Dominion Statistician, to make his opening statement.

Mr. Walter E. Duffett, Dominion Statistician, Dominion Bureau of Statistics: Thank you, Senator Lamontagne. I would like to make a few preliminary remarks by way of summary to indicate the principal points in our submission.

As you are aware, our submission consists of a fairly lengthy brief and, in addition, two important memoranda, one of which has to do with research and development surveys in the physical sciences and the other has to do with the possibility of research and development surveys in the social sciences.

I am very happy to be here today, with some of my colleagues, to contribute to the work of this important committee, especially as it moves into the field of the social sciences. While DBS contributes something towards an understanding of the physical sciences, through its surveys of Research and Development in Government and in industry, our principal contribution is in the support and encouragement of work in the social sciences. Even this, of course, is not the entire measure of DBS activities. For example, DBS produces data more specifically intended for operation

a and business uses, and we also make important contributions towards statistical and survey methodology and analysis in itself.

As will be seen from the DBS brief, the organization is a fairly large one, covering a wide range of activities. Our primary obligation is to satisfy the needs of users of statistical information, but we have certain other responsibilities, arising in part from our main duty.

Among these are, in the first place, to co-ordinate the statistical activities in Canada. There is a phrase in the Statistics Act which refers to this. That is: generally to organize a scheme of co-ordinated social and economic statistics pertaining to the whole of Canada and to each of the provinces thereof.

This is a large responsibility, and a responsibility which is rather difficult to carry out because, in doing so, the Bureau does not have legal powers; it operates largely by persuasion and by example.

Another function we feel is important is to understand and to do a certain amount of research in the subject matter fields where we have responsibilities. Some research is carried out in the fields of productivity, price movements, balance of payments, financial institutions, demography and manpower.

This research has two functions. The first is that in many cases it is possible to do rather better work in certain respects in the Bureau of Statistics if those who do research have direct access to the data. The other advantage is that doing a certain amount of research on the premises, as it were, is a stimulus to good statistics, because those who carry out these investigations ask important and significant questions of those who are actually producing the data. I may say that it is also a factor in retaining and attracting good staff.

A final area in which our activity is of some importance is in the field of survey methods research, research in matters of data processing input and retrieval, and automation. These matters are also described in the report.

The Bureau of Statistics is rather a large organization. We have between 2,800 and 2,900 people on the

staff. This is the product of rapid growth, mainly since the war. The growth has taken place in two stages. The growth in the immediate post-war period related to the experience of wartime, in which Government had been quite successful in influencing the economy; and it was related also to the experience of the depression, and reflected the hope that by a degree of Government intervention in economic affairs it would be possible to avoid the unemployment which was such a serious matter in the late thirties. The second period of rapid growth has been since about 1962. During this period the staff of the Bureau has grown from about 1,800 to between 2,800 and 2,900. Of the staff now between 400 and 500 are professional; that is, people who have university or equivalent background. This is a somewhat larger professional complement than is often thought of as being involved in a statistical agency, but it is a very important one.

The growth during this period since 1962 occurred and reflected demands at all levels. The federal Government during this period set up a number of new agencies — ARDA, the Economic Council, the Energy Board, the Atlantic Development Board, the Manpower Department, and a number of others — all of them requiring statistical information in order to make the decisions for which they were responsible.

During the period also it will be recalled that a number of important Royal commissions met. They required statistical support and, in most cases, their recommendations included the suggestion that the economy required either additional administrative activities or additional statistics. I need draw your attention only to the Royal Commission on Banking, the Royal Commission on Health Services, the Royal Commission on Bilingualism and Biculturalism.

Provincial and municipal demands for statistical information were growing rapidly at the same time. There were equivalent institutions, in some respects, set up in the provinces and, with the rapid growth in population, urban problems became an important consideration, and in order to resolve these more data was required. The business community had always been important users of Bureau of Statistics material, but in recent years this too has accelerated. To some extent it may have reflected the minor recessions which occurred from time to time during the post-war period, and perhaps also the influence of parent companies and associated companies in the United States where market research and statistical analysis play a very large part in the decision-making process of the community.

Universities also in the post-war period became very much involved in quantitative research of this kind, and in some cases set up survey organizations of their own which, in turn, were based on DBS functions.

There are interesting contrasts in the use of statistics illustrated by growth in recent years. During the

twenties I suppose one can say that statistics were mainly used for information, presumably to describe phenomena and developments in society, but to an increasing extent statistical information has come to be used for decision-making, and this requires, generally speaking, two different levels of statistical sophistication. Statistics used for general description can be relatively elementary. Timeliness is not of the same importance. But when one moves into the decision-making area, then statistics have to be much more precise and up-to-date. The products of the Bureau of Statistics are described in detail in chapter 6.

Perhaps I might just say a word or two about the magnitude of our output. It consists in the first place of publications. In one year this amounts to a total of 500 regular publications appearing annually, monthly or quarterly, and some 200 occasional publications appearing at less frequent intervals. The census always generates a large number of publications. In the case of the 1961 and 1966 census we had a total of around 400 publications. The details are set out in a D.B.S. document which has been distributed. In addition we distribute machine-readable output in the form of computer tapes and punch cards. One example is something which has been developed over the last few years, and that is a data bank which will contain from five to seven thousand publishable statistical time series and which I believe will be of great assistance to people doing econometric research and business analysis.

We also do special tabulations for users within the limits of our resources and a very large number of inquiries by telephone and by letter are dealt with in the course of a year. There are also some secondary distributions since a good deal of our material is used by newspapers and trade journals.

Timeliness is one of our most important concerns. This relates to the statistics which are increasingly used for decision-making processes for government and business. For this reason it is important that the data be as timely as possible. If you wish to discuss this in more detail later, I shall be glad to comment on it.

Another matter which is probably related to your interest in statistics on research and development is that of priorities. The Bureau of Statistics is asked to produce much more data than it can do with the resources at its disposal and I think a demand greater than supply is likely to be the characteristic of the statistical business for many years to come. Consequently it becomes necessary to set up a ranking of priorities. This is a very difficult process. In its more sophisticated form it is referred to as cost benefit analysis. The work we have been doing over many years is very much in line with program budgeting ideas which the Government is now adopting generally. The process initially involves determining the costs of these data. This in itself is rather difficult. The

machinery for doing this is not yet perfect, but we anticipate over the next year or so to have a much better and more complete costing system. The matter of benefit is an exceedingly different one. It involves establishing how to use the data and who will use the data, which in itself is difficult, and then determining for what decision-making process or what policy-making process the data is used and then in turn establishing how much difference the statistics make to the quality of the decisions when they are made. We are not aware of all the ultimate users of D.B.S. material because as I say there is a certain amount of secondary use of the material. For that reason it is difficult to establish who the ultimate users of D.B.S. materials are. We do our best to find out as much as we can about who uses the data and what they use it for. Inevitably from time to time a certain amount of intuition enters into this process. It is very valuable to have the recommendations and investigations of commissions and committees, committees such as this, expressing views about the importance of and need for certain statistical series. These help us in deciding what the priorities ought to be.

The current activities of the Bureau of Statistics are described in this brief rather concisely, but we point out also at slightly greater length something about our plans and programs for the next few years. This is contained in chapter 13 and is something you might wish to examine or question further about subsequently. The plans include activities under a number of headings.

The first of these is planning itself. We feel our planning and costing areas need to be improved and can be improved. We have already acquired some additional staff for this purpose and hope there will be a great improvement made in years to come.

Automation, mechanization and computerization and other improvements in the production of statistical data are of the greatest importance. Staffing and training, as you will recognize, always constitute a problem for organizations which use a number of professional staff. There are significant staff shortages which prevent us from carrying out certain things which we have the financial resources to do. This means we have to do a little better by way of recruiting and considerably better by way of internal training arrangements for professional staff. The bureau undertakes a certain amount of technical training, and we are planning to do somewhat more of this. Then in addition we have quite a long list of high priority statistical programs which are set out in some detail.

The nature of these programs will illustrate the work of the bureau in providing the foundation for research in the social sciences. In this regard we are very well aware of our obligations, all the more so because many, perhaps most of the D.B.S. staff is of a predominantly social science background. We maintain

our contact with the universities and government departments and others to find out the needs in the social science fields. Then we have international links with bodies doing social science work and providing social science type data in other countries and in studying methodological matters.

The two topics which I suspect you may be interested in to quite a considerable extent are the D.B.S. surveys in research in the physical sciences and, secondly, the possibility of a survey of research in the social sciences. In the case of the physical sciences there are two surveys, one in industrial research which is a biennial survey and the last report covers 1965. The second is a survey of research in the physical science in the federal Government. This is an annual publication and the latest one for 1966-67 has just been published. A memorandum has just been prepared and circulated by one of my colleagues on this program and I might mention a number of highlights. Most of these surveys began around 1956 and 1959 and it is interesting to note that public interest was not very evident until 1964 but since then there has been greatly increased interest in these topics. The survey of industrial research is, as I say, a biennial project and it includes in addition some research foundations maintained by the provincial governments. This survey is reasonably well established, I think. The possibility exists now of making the report an annual one, and we have assigned additional staff to this project for the year 1969-70 in order to work towards an annual publication. As is natural in the case of a biennial report there is a significant time lag from time to time. However, an effort is made to publish preliminary figures in the D.B.S. Daily Bulletin some seven months before the appearance of the publication itself.

The report on research in the federal Government area is much the same; it is an annual report and the latest was published for the year 1966-67, and here too a preliminary report is published well in advance of the printed one.

Research in the universities is an area which has yet to be investigated. It is a particularly difficult one because research and teaching are combined and sometimes it is difficult to get adequate access to the people doing the research. Nevertheless it would logically follow as part of our present program.

There are also other organizations which have done other work in this field such as the National Research Council and the Medical Research Council and so on and it is possible with these increasing activities that a greater co-ordinating role should be played by the D.B.S. than we have performed up to now. There are two DBS officers present, Mr. Leclerc and Mr. Stead, and they will be glad to answer further questions if you wish them to do so.

Finally, a word about research in the social sciences. As you are probably aware, we do not, at present, have a survey program measuring the extent of research in the social sciences in Canada. The program has been under consideration for some years with intermittent discussion with potential users. Expressions of need have been, as I implied, intermittent and really not very strongly supported by reference to policy, planning or decision making and these are the considerations which induce us to initiate survey activity. In particular, there has not, until recently, been a very great interest in Government, in survey of research and social sciences. In other words, the idea has been on the DBS shopping list, but it has not had by any means first priority. Nevertheless some planning has been under way.

Around 1964 and 1965 planning was begun concurrent with some small beginnings by UNESCO and the OECD, but even now these bodies are still very far from establishing international standards. This is a measure I think of the difficulty of the job.

A DBS officer in 1967 visited the principal western European capitals to determine what work was being done, and to get some impression of the quality of the work and I think he found, at that time, that those who had attempted surveys of research in social sciences were disposed to concede that there were many problems and that their surveys were neither very complete or very accurate.

However, as the result of this work the bureau staff is now in a position to appraise the nature and the magnitude and the pattern of the job and indeed the memorandum which has been circulated is evidence of this.

We plan to add additional staff early in the new fiscal year to begin active exploration of the survey needs of users with the idea of setting up a regular survey in this field in due course. It may be that members of this committee felt that this is not soon enough and that the balance of their deliberations would be aided by some very rough impression of the order of magnitude of a research in the social sciences.

This can be approached in two ways. One of my colleagues has been doing some very, very rough assembly of information on this topic and I think he would be glad to speak to you briefly if you would like him to do so. In addition, if there is time, before you reach the end of your deliberations and prepare your report, we would be glad to try to hire additional staff to do further examination of the approximate extent of research in the social sciences, at least in the federal Government.

Now, it may appear that we are making rather heavy weather of this and that the problem is not all that difficult; we should be able to produce something pretty useful in a very short time. We would try, but there are very important practical difficulties reflected

in the failure so far of OECD and UNESCO to reach international standards. I might mention the sort of problems that exist—in the nature of government accounts which are not designed to yield information of this kind. Then there is a good deal of overlap and confusion between data collection and research. It is a characteristic of social sciences that a great deal of time and effort is normally necessary for collecting data. Also, in the government departments, people who undertake research in the social sciences are the same people who are involved in collecting information for intelligence purposes, and to assist in policy development. They are often involved in administration and if they have a little time left over they do some research. Consequently, this is a little difficult to sort out. Nevertheless, as I say, if it is your desire that we should try and provide some information here we will do our best. I think that is all I need to say by way of introduction.

The Chairman: Thank you, Mr. Duffett. I and members of the committee will agree that we have received a most complete presentation from the Dominion Bureau of Statistics. I would suggest that during the discussion period we first deal with the main presentation, and when we are finished with this we could devote some time to the two annexes we have received, one entitled "The Present DBS Surveys of Scientific Activities" and the other which deals with the measurement of research in the social sciences. These two annexes were, as a matter of fact, being discussed by Mr. Duffett at the end of his opening remarks. So, if you accept this procedure we would then deal first with the main presentation, I would ask Senator Lang to initiate the discussion.

Senator Lang: Mr. Chairman, I must start off by saying I am not very familiar with the role of a statistician and I come to this problem with an extremely lay approach.

The Chairman: As common sense.

Senator Lang: If Mr. Duffett would help us get to the role of the DBS in perspective by telling us how these problems are—I mean the kind of work you do and how they are handled, say in the United Kingdom or the United States or any European country. Are statistical matters dealt with by centralized government agencies or various government departments? How, for instance, would it be handled in the United States or in a very broad outline, in the United Kingdom as compared to our own system?

Mr. Duffett: You mean statistical matters in general?

Senator Lang: Yes.

Mr. Duffett: The United Kingdom and the United States are to some extent unique, because they have a

greater degree of statistical decentralization than is common in most other countries.

In principle, the American system is the most decentralized of all. The only major centralized type of body is the Bureau of the Census which undertakes surveys of the industrial activity and undertakes the preparation of the trade statistics. Beyond that, statistics are carried out throughout the administrative agencies of the United States Government. The Department of Agriculture, the Bureau of Labour Statistics, the office of Health Education and Welfare, all have statistical functions of their own. So, there is a fair degree of decentralization.

However, it was very soon discovered that this was unsatisfactory, that the statistical agencies in these various Government departments were going off in rather diverse directions, and they were using different definitions, and there was a certain amount of duplication. It was difficult for the budgetary process to exercise adequate control, so an agency known as the Office of Statistical Standards was set up in the Bureau of the Budget. It is a very strong and a very large co-ordinating body which attempts, within the U.S. government, to do what we attempt to do within the Dominion Bureau of Statistics in relation to the various divisions.

In the United Kingdom somewhat the same situation exists. The departments of government collect a variety of statistics. The Registrar General collects information on vital statistics. The Board of Trade collects trade statistics and some on industrial activity. But here too it was found necessary to have a central co-ordinating body. It is known as the Central Statistical Office. It not only exercises a very powerful co-ordinating service, but produces some of the major statistical aggregates, national accounts, gross national product, national income, etcetera. That office is now undertaking a more active centralizing role than in the past, but there is a degree of decentralization in the actual collection of the data.

There is a good deal to be said for a highly centralized statistical setup such as we have in Canada, and for a decentralized one such as in those other countries. If you wish me to go into it, I will do so.

Senator Lang: Do we have a rather comparable problem as between DBS and provincial government agencies in statistical research?

Mr. Duffett: To a much lesser degree. The provinces have become more active in statistical matters in recent years, particularly the Provinces of Ontario and Quebec. It has been possible for us, by frequent meetings and by committees, to be very close to the provinces and to avoid the duplication which otherwise might exist if the provincial statistical agencies were to go off on their own.

Our relations with the Province of Quebec on this matter are very close. For example, we use the same forms, the same questionnaire forms, in a variety of important fields—in fields such as industry, mining, agriculture, forestry, and some others. What happens is that the forms, in a typical case, would be sent out in duplicate from the Bureau of Statistics to respondents in the Province of Quebec. They would be two identical forms. They would be put into the typewriter and completed, and one copy would be sent to us and the other to the Quebec Bureau of Statistics. In this way we avoid most of the disadvantages that might arise through duplication.

Senator Lang: Does this apply only in Quebec?

Mr. Duffett: It applies in the Province of Ontario and, to some extent, in the other provinces which have substantial survey activity. Wherever substantial survey activity exists, joint arrangements of this kind tend to exist also.

The Chairman: You were describing the decentralized system which exists in the United States. Do you think there is more or less a similar trend here which is not going as far as the U.S. system, but do you not think there has been a tendency more or less recently for various departments to start a data collection system, or am I wrong?

Mr. Duffett: The Treasury Board is very sensitive to this. For example, as a result of a suggestion by the Glassco Commission, all federal Government departments sending questionnaires to more than 10 respondents are required to notify the Bureau of Statistics. This system has been underway for several years, and we have not found very many cases, in fact, scarcely any, in which this represents outright duplication.

There have been some trends in the opposite direction, DBS being involved in more activities previously carried out by government departments. For example, just over a year ago we took over the Aviation Statistics Centre of the Department of Transport. This represents a DBS satellite operation within the Department of Transport, but one for which we have full responsibility. There are some statistical activities still going on in other Government departments. Generally speaking, we are aware of them, and we are in touch with them. For the most part, I think they are quite happy to use the services of the Bureau of Statistics, if the Bureau of Statistics can meet their needs.

The main limiting factor is our capacity in terms of financial resources and manpower—and mainly manpower—to meet their needs. If we cannot meet their needs, there is a strong tendency for them to go ahead and collect data themselves.

Senator Lang: Following from that remark, I would take it your resources are inadequate to meet the demands placed upon you. In terms of your total demand, could you give a rough idea of what the federal Government requirement is, as opposed to outside, and as to outside, as between, say, universities and the private sector?

Mr. Duffett: Yes. Just to deal with the first point you made, that our resources are inadequate, yes, they are inadequate. I think that with the increasing demand for statistics and the usefulness of them, our resources probably will always be inadequate. In recent years it is evident that the federal Government, Treasury Board have recognized the role of statistics in the decision-making process in the country, and I do not think we have grounds for complaint that we have been provided with insufficient financial resources in recent years.

There was a time, before 1960, when the Bureau was very short of resources and was unable to build up its professional staff at a time when this would have been relatively easy; and our problems now stem from that earlier period of scarcity.

As to the use of statistics, I cannot answer your question directly. I do not know what proportion of our resources is devoted to the federal Government, provincial and municipal governments, to businesses and universities. I do know that the Bureau of Statistics provides greater services to the business community, proportionately, I think, than is the case in any other country, with the exception of the United States.

The business community in Canada has the habit—and I think it is a good habit—of using statistical data in arriving at its decisions, in market surveys and so on, and we devote a great deal of time and energy to encouraging the business community to use the data. We have set up, in Montreal and Toronto, statistics use officers to establish contact with the local business community in order to serve them as well as we can.

The Bureau of Statistics budget is \$27-1/2 million. This is a large contribution by the federal Government to the decision-making process in society, and it is important that this should be as widely used as possible, because statistics contribute to good decisions, and good decisions are the means of increasing efficiency and productivity, and of avoiding waste.

The proportion of our services which goes to the areas you mentioned—Government at various levels, business and universities—varies a great deal from time to time. I think it is pretty clearly the case that in recent years the universities have absorbed a great deal more of our attention than has been the case in the past. I would guess that during the last four or five years there has been a greater demand by Government departments, at all levels of Government, than there

has been from the business community, partly because the business community was very well served before. Government, on the other hand, has been setting up new agencies which require statistical information for their purposes.

The Chairman: I think, Senator Lang, we should really concentrate on this issue you have just raised. If you want to pursue this it is quite all right with me. But before you leave it, I think there may be others who have supplementary questions about the scarcity of personnel and the staff situation. If you allow such questions to be asked at this stage I think it will provide for a more orderly discussion.

Senator Lang: I agree completely. To carry on in the same line, in view of the pressures upon you to meet certain demands as between these various sectors, and I suppose interdepartmental demands themselves require that you must select certain areas of priorities as between one area and another, how is this process handled? How do you ascertain the priorities, or are they set for you?

Mr. Duffett: I would not say we set priorities. I would not say any civil servant sets priorities. He makes recommendations. But in making these recommendations I must say that we receive reasonably free hand from Treasury. They recognize we work very hard in trying to achieve a proper scale of priorities. As I mentioned before an important element of setting priorities is to know precisely what the data is used for. One cannot justify the provision of statistical information because it would be nice to know or because it is of interest. For the most part we must concentrate on the important areas of information for the public at large and on important decision-making processes and it is these which we attempt to explore as fully as possible before deciding where additional resources should go or whether in fact at times it might be best to discontinue certain activities. On a number of occasions the Governor of the Bank of Canada in his report explained, as he had explained to us beforehand, that it is of the greatest importance to have good information on prices and other factors in the economy as a basis for monetary policy.

The Chairman: The Economic Council has done likewise.

Mr. Duffett: The Economic Council has done the same. Their reports over recent years have nearly always indicated areas where they felt there were particular needs for data. It is this process which goes on continuously. The bureau has within its various divisions people who are very close to industry, to universities and to particular government departments, and they feed in to the executive committee of the Bureau of Statistics their views of what is important. A few years ago we set up a relatively elaborate process for providing statistical data to the National

Energy Board. They had very important decisions to make involving the disposal of large sums of money. The information we had prior to that had been adequate to describe in general terms what was going on in the petroleum industry, let us say. But they required something better because they had vital decisions to make and I think we satisfied them.

The Chairman: What about charging a fee to any particular government agency which wants you to initiate a new data collection system? Would this help you in determining your priorities?

Mr. Duffett: I think it would. Money talks.

The Chairman: This has been done in a few cases.

Mr. Duffett: Yes; for example, we have undertaken a large and expensive project for the Department of Manpower and Immigration, a study of job vacancies throughout the country to see how best to fit the local unemployed population into the various vacancies that exist. They have agreed to pay the Bureau of Statistics to undertake this. In a number of other areas we also charge for services, but not very often. One of the reasons we have not done so in the past is this: If we charge, we do not retain the money in our own hands. The long arm of the Receiver General reaches out and receives the money and we cannot use it to acquire additional staff. However, we have an arrangement now under discussion with Treasury Board for the establishing of a rotating fund of money out of which we will finance survey activities and which will be replenished by the charges made. Mainly, the charges for our services simply consist of charges for publications, and it is very small. But it is of greatest importance that the community should use good information in making decisions, and there should be as few obstacles as possible to their using this information.

Senator Lang: Sometimes the public feel that what they get for free is not worth-while, at least not as worth-while as if they had to pay for it.

Mr. Duffett: They don't get it free, and if we make special statistical surveys they pay for the job.

Senator Lang: Are you in competition with private statistical information services?

Mr. Duffett: No, we supplement them.

Senator Lang: I think there is a lesson in that in that the middleman might be cut out. I see a tremendous difficulty if you have an urgent demand to produce statistics for the Dominion-Provincial Conference, next week, and also if there is a monetary crisis coming up and the Bank of Canada is on your back. Then you have to consider the situation and decide

how to allocate your resources. I wonder if these priorities should not be in some other interdepartmental body or Treasury Board area.

Mr. Duffett: The priorities are decided in consultation with a large number of users. For example, in considering the list of questions to be asked in the 1971 census, we had to have a multiplicity of discussions with various people. We have been in discussion with the government, the provinces and the business community.

The Chairman: I am sure your main activities result from either statutory or historical obligations. You have to take a census every five years now, and you have no choice. This is imposed on you.

Mr. Duffett: Your reference to historical obligations can be extended. In fact the process is not quite so difficult as you might assume because a statistical system is now pretty well established, and while we take a hard look at our system at program review time each year, we are preoccupied mainly with requests for additional information which are not as large in bulk. We are very conscious about tampering with existing statistical procedures or series because these tend to have been built into the decision-making process of government, business firms and trade unions. For example, one very important matter is the consumer price index which is used as an escalating factor. Many of these things we would be very careful about before we would disturb them. It must be remembered that in many of these there is a large element of stability.

The Chairman: Any other questions on the priority of staff problems?

Senator Cameron: The provinces all have their own statistical departments and some business firms have quite elaborate ones. I am wondering in looking at the mobilization of the total resources for gathering statistics in the country what machinery you have for co-ordinating these different agencies, and this could relate to the whole matter of priorities too if you know what each one is doing. Is there any formal machinery for the co-ordinating of statistical gathering agencies in Canada?

Mr. Duffett: There is no single co-ordinating committee. A single committee situation would be very difficult to handle because of the multiplicity of the things which we do. There are very many links with the statistic producers and users. For example, last week we had two days of meetings with the officers of the Quebec Statistical Bureau. At the end of February we are having three days of meetings with the statistical agencies of the provinces. These have greatly improved in size.

Within the federal Government there are a number of major committees and a number of smaller ones. There is an interdepartmental committee on economic statistics which meets at intervals and at which we set out our programs and suggestions to the government departments and attempt to meet in a balanced way their needs. I believe on February 19 there is a meeting of the federal provincial conference on agriculture statistics and our program will be discussed with the provinces. The provinces in this case are both suppliers and users. They collect a certain amount of information and they transit it to us and we produce a certain amount of data they find useful.

For a single body, as a statistical council of Canada, the Glassco Commission made a suggestion somewhat along these lines. The suggestion however was not very clear, as to whether they were talking about users or suppliers of data. It was one of the suggestions, and one of the few suggestions of the Glassco Commission that was not implemented. We have been hesitant to do this. There would be advantages, but to service an organization of this kind would be a substantial subtraction from our resources. We would have to have two or three people doing very little else. We found in practice that it would be difficult to imagine how it would operate. If it was going to be representative we would have to have people representing such fields as education, welfare, judicial statistics, financial statistics and a balance of payments. You would probably have to have some geographical distribution and the organization would become enormous. The meetings of the organization would be difficult to manage, because a discussion on any one topic would interest one or two people, whereas the others would be very much concerned with their own interest.

Senator Cameron: There are two cases that I would say are priorities and rather urgent today. I wonder how you establish them. A very large one is the needs of the Canadian Association of Universities and Colleges for projections on the student enrolment and the costs and so on. This cuts across both federal and provincial lines and university lines. That is one thing. Another one is much more current and it reflects to the private sector and that is the current foul-up over the distribution of boxcars. I do not know whether you come into this picture or not, or whether this is left entirely to the railways, as a private organization, but it is quite obvious that something has not worked out or has been overlooked. Do you come into this in any way, because this is a matter of urgent priority right now?

Mr. Duffett: Dealing with the boxcar thing, in the first place it is my impression that we do not play any part in this. We have in the past given some assistance. Some years ago I think there was a royal commission or committee dealing with this problem. Mr. Bracken I think was chairman of the commission. On that occasion we loaned some expert staff to deal with the

problem. The problem has statistical elements and mathematical elements in it, but as far as I am aware that is as close as we have gotten to the boxcar problem. I am sure they have statistically and mathematically oriented people working on the problem.

Senator Cameron: You can see it is a critical matter of Government policy right now and can we assume then that the Government has not responsibility for the fact that we have not got this? If that is the case, where do we go to, the CPR, the CNR or the Board of Transport Commissioners?

Mr. Duffett: I would assume the Board of Transport Commissioners is the appropriate place to inquire and I would assume they would use techniques which might be similar to the ones we use, but the problem is not so much a statistical problem in itself, but a management problem.

Senator Cameron: To solve the management problem you need the proper statistical information.

Mr. Duffett: You do, but in many cases I strongly suspect that those responsible for them are busily collecting their own statistics. If we were able to do so we would be prepared to help them. If we would have requests for assistance it would take highly skilled people of which we do not have many and it would, as you imply, be a matter of priorities as to what we would do without in order to do this.

Your other question has to do with educational statistics. Universities, colleges and another similar bodies require more data than now, especially up-to-date information for decisions which are very important and have large amounts of money involved. In this respect we have had difficulty in maintaining a staff in the education division of the Bureau of Statistics. We perhaps set too high a standard in terms of the director we are looking for. We have not had one for several years and as a result I think quite frankly we did less than we should have done. We finally decided that the matter required proper examination from top to bottom. We obtained the services of Professor David Munro of Macdonald College who is also joint Chairman of the Superior Council of Education in the Province of Quebec. He produced a very useful report that we are now in the course of implementing. This has been discussed with the Treasury Board officials and it is our hope that we will be able to approximately double the size of the education division of the Bureau of Statistics within the next two or three years. We are still searching for a director of sufficient expertise to fill the job. We have a number of people in mind and I am reasonably confident we are on the uptrend, but there is a problem.

Senator Cameron: Related to that, you may have read the discussion which took place in the Senate not

very long ago on the role of the Dominion Bureau of Statistics and the needs. In fact, the urgency of more current statistics. For example, you will get a report and the latest figures are 1964 or 1965. These are not very useful in terms of preparing a budget or preparing a projection for providing facilities, classroom space, teachers and so on for 1970. Is the reason why these are not more current, the fact that you have not been able to get enough staff or what?

Mr. Duffett: Regarding the education statistics, the timing I think is now rapidly improving as the result of an acquisition of a new chief of the higher education section. I cannot quote you a figure on the speed with which the timeliness is improving, but there is a catch-up process taking place very rapidly and it was simply a matter of insufficient staff at the right time. We had the positions, but we did not have the right kind of people. I agree with you.

Senator Cameron: What is your normal source of people, to fill positions like this?

Mr. Duffett: We tend to employ people from what we would regard as the appropriate source. We attach a great importance to the professional staff involved in these surveys having an appropriate professional background. The professional staff in the educational division nearly all have educational backgrounds. The man we have employed and hired a short time ago to head up the higher education section has been assistant registrar of Laval. He also had some IBM background, which was quite a help too. This is, in many ways, the ideal solution to the problem.

Senator Cameron: I wonder if it is. Is there any specialized training program in Canada for training people in this field? You said that a registrar was an ideal person. Having had a lot to do with registrars, I would question that opinion. I think they are too nipping. They may have to be in their jobs, of course.

The Chairman: There are always exceptions.

Senator Cameron: Well, this is true.

The Chairman: Especially at Laval!

Senator Cameron: But this is such a highly specialized job, and it is of so much importance to our whole economy today, is there any place, any university or institution, offering specialized training for this kind of work?

Mr. Duffett: I am not quite sure what you mean by "specialized training." We attach great importance to people in charge of the statistical area being well informed in the subject matter of the area.

The Chairman: These are your two requirements.

Mr. Duffett: There is the requirement from time to time for statistical skills, mathematical skills, but these skills, in many respects, are served by the group under Dr. Fellegi who are specialized mathematicians. So, we do attach great importance to getting people who have particular skills. This means there is no one place from which you get people to do all things. The man in charge of the energy statistics has a geological background. This is very important and very relevant. As far as educational statistics are concerned, we like to get people with some knowledge in the particular area with which they are concerned. We required someone to look after adult education statistics, and we now have a woman who has done a good deal of work in this field.

As to whether registrars make ideal statisticians, jobs of this kind require a combination of skills. It is exceedingly unlikely one will find in any one person. We try to arrive at ideal solutions by hiring the best person we can find and by supplementing his background in a variety of ways. This particular man has been working very closely with the AUCC staff, and they themselves have contributed greatly to his integration into this job.

Dr. Simon A. Goldberg, Assistant Dominion Statistician, Dominion Bureau of Statistics: May I just add a point here? As you are implying, and as Mr. Duffett was indicating, the statistical activity is becoming an interdisciplinary matter. The way we have been trying to face this problem is, first of all, to try to find people who can speak to the users. That means subject matter experts. They have to see the needs and be able to evaluate the needs, and come back to the Bureau and get into contact with people who have access to the various technologies—for example, the computer technology and also the science of taking surveys, the pure statistician, the mathematical statistician who has had experience in designing surveys. Together these people work out the best approaches to developing statistics.

Senator Cameron: I would agree that you must have someone thoroughly knowledgeable in the field of study. That goes without saying. But that is not enough, and I am wondering if this is one of the reasons why there is so much delay in getting the statistics current. They need to know how to use the new tools of information and information retrieval. I wonder if there is a need for a specialized training program to have knowledgeable persons, whether in education or energy or labour resources, and bring that person, and a lot of others, and put them in some kind of program or course where they are exposed to the new tools we have. The computer is the obvious one, but the answers that come out of a computer are no better than what you have put into it. If you are going to get the benefit of the results, there must be some training of skilled people who are going to use the tools.

Mr. Duffett: I think that is quite right. We are in the process of replacing a rather old computer with an up-to-date computer in the Bureau, and an attempt is being made to bring in people from the United States and Canada to create in the minds of the subject matter experts an awareness of how these tools can be used.

As Dr. Goldberg has said, we do have in the Bureau of Statistics interdisciplinary skills. One of the greatest problems, of course, is the frontiers between these skills and to arrange it in such a fashion that the people on both sides understand a little of one another's responsibilities.

We do not often find a subject matter expert who has some computer background, as the man in question had. So it becomes necessary, I think, to do a good deal of training and education. Some of this can be done, I presume, through the regular education system, and we certainly take advantage of it. To quite an extent I think it could be done within the Bureau of Statistics. This is one respect in which we have not had adequate resources in recent years, and I think certainly it is an area in which we intend to improve our performance in the next few years. It may be necessary and desirable for us to employ one or two university professors who have the sort of teaching skills that we need to work with our staff. This is one way of doing it.

Senator Grosart: Have you anything in any way comparable, say, to the crash training plan the Treasury Board has under way in connection with the new five-year projects?

Mr. Duffett: You are referring to the program budgeting work?

Senator Grosart: Yes.

Mr. Duffett: The senior officers of the Bureau of Statistics and members of the Executive Committee, seven or eight people, have taken this course, and we are now in the process of implementing it, so I think this is the appropriate way of becoming knowledgeable in this field.

The Chairman: But this is on quite a different problem. This is to improve the management within the Bureau. It does not help the other problem.

Senator Grosart: Yes, very much so.

Has DBS anything comparable to this crash course, where they brought in 400 people and have given them an intensive one week course of training in their requirements? Here they are very similar; the new skills and techniques that you have in the Treasury Board program are similar.

Mr. Duffett: We have some, and could have more. Within the last month we had an expert in computer matters from a well-known and very successful company in New York, who spent two weeks of lecturing in the Bureau, one week dealing with our computer experts and another with the subject matter people. Where we can find people capable of doing this kind of thing, we welcome them and look for them.

Senator Grosart: May I ask you another related question arising out of Senator Cameron's general questions. What percentage of your total work load, by man hours or any other standard you wish to use, is from inhouse initiated research compared to referrals. Do you have a rough figure?

Mr. Duffett: That is a rather difficult question to answer. We are ultimately oriented towards production of data for purposes outside. In the course of preparing that we provide two classes of data. The first class is an elementary group such as retail trade statistics, international trade and things like that which we tabulate and publish. There is in addition to this a much more highly developed activity that goes on, in which the data within the Bureau of Statistics is brought together within the bureau to constitute more sophisticated information. There are a number of examples, one of which is the national accounts. Input and output is another example. Is this what you had in mind?

Senator Grosart: Not quite. Perhaps I can put my question best this way: Obviously there is a group of statistics which we may call standard statistics, and they are growing in importance because there are international standards under OECD as to what basic statistics each country should provide. Obviously Canada will not be merely interested in those alone; there will be some in particular that will be of special importance to Canada. This is the ongoing responsibility of the Dominion Bureau of Statistics. In addition to this I presume you get requests such as Senator Cameron just mentioned for specifics from universities, or from the Department of Labour or from industry. I am wondering how this divides, because to me this is an important question inasmuch as the relation between referral work and in-house initiated work is going to determine the whole structure of this research.

Mr. Duffett: We already have in Canada a fairly highly developed statistical structure so that most of the needs for statistical data in the country are satisfied either by publications or by limited retabulation of data which we already have. From time to time we do have requests for special publications of one kind or another. We will do these if we have the resources and if we can see our way clear to acquiring them.

The Chairman: We were discussing this a little while before you came in, senator. I think it would be true to say that most of the work of the bureau comes from inside because of the obligations, either statutory or historical, imposed upon you. But the ultimate users, of course, are all outside.

Senator Grosart: I am sorry if the question was asked and answered. I apologize for being late but I was in another committee. All I can say, Mr. Chairman, is "Stop me if you have heard this one."

Mr. Duffett: Perhaps Mr. Goldberg would like to comment on this.

Mr. Goldberg: If I understand the question, and I may not have, it boils down to: Where does the initiative rest in initiating new surveys or new research?

Senator Grosart: Not only new, but the total.

Mr. Goldberg: Going back in history, it mostly initiated outside. Even legislative projects have initiated outside. What we try to do is anticipate and prepare ourselves for what will be requested from outside so that we are in a position as quickly as possible, first of all, to evaluate it and then where it looks as though it should be given priority, to ask Treasury Board to give the authority to get the resources to act on it. This is why before you came in the emphasis was placed on the importance of the bureau having the expertise which we should develop inside and this applies not only to mathematical and computer expertise but also, and this is very important, that within the bureau we have people who understand the purposes for which the information is used and will be used. The answer to your major question, I would say, is mostly outside except we try to anticipate as much as we can and to prepare ourselves.

Senator Grosart: The reason it is important today is that the evidence we have had in this committee indicates that we do not have in Canada the research that we should have. There are obvious reasons for that; we don't have the large industrial companies that are able to do it, and our size factor puts us in the position of not having the research resources that are available, for example, in the United States. The purpose of my question is to ask where does somebody go who really badly needs information. I might say that I myself over the years have gone to the Dominion Bureau of Statistics many times, and I have even charged clients for some information I got from DBS when the client, which might have been an industry, had not known that the DBS had unpublished material. I am not complaining about the co-operation received from the DBS, because it has been wonderful. Have you or should you or would

you like to have more money and manpower to respond to far more requests than you are responding to now?

The Chairman: That is not a very difficult question.

Senator Grosart: I think the question is apropos because we are, in this committee, dealing with the allocation of R & D funds—public funds.

Mr. Duffett: I would like to make one or two comments on that. In the first place I should say that something was said before you came in, and that is that in recent years we have no grounds, and I don't know that anyone has any grounds, to feel that the Government has been niggardly in providing financial resources for statistical work. They recognize the importance of what has been going on. We could have used more, but we have done reasonably well. An organization that increased in staff from 1,800 in 1962 to 2,900 now should not really complain about resources. One of the problems is to get the skilled manpower and to retain them and to train them if they require training. I feel we should do more than we do, but at the same time I strongly suspect we will find it difficult to satisfy all the demands that are raised for statistical services. I am in the habit of pointing out that Canadians generally would like to have an American standard of living on a Canadian income. This applies also to statistics. The example we have beside us in the United States is a great source of stimulation. It comes to us in a great variety of ways, among others being the direct contact we have with our counterparts in Washington. This country can only produce so many trained people of the kind necessary to do all these things.

The Chairman: It seems to me, to pursue this for a moment, that so far as I know the main criticism which has been made by people about the bureau is that it is not doing enough. This is a wonderful criticism in a way. I think that this is a criticism which has been made, and it was not really a criticism at all but an observation and a recommendation to do more. But this has been done. This point has been made by the Bank of Canada and it has been made, I think, on various occasions by the Economic Council of Canada. I see the chairman of the council is with us now, probably rehearsing for this afternoon. But this has been their work and different other agencies have raised that point.

You told us this morning that you do not have real financial constraints so far as acquiring more staff. You point out the same thing in your brief, that you certainly have staff, but you discuss the problem of recruiting skilled personnel and you refer also to the high rate of separation. How would you deal with these two things? Perhaps especially the latter.

Mr. Duffett: Well, every process I suppose has a bottleneck. If you resolve one bottleneck you have another one. At the moment the bottleneck is in terms of being able to recruit sufficient experienced staff and retaining them. There have been times where finance has been a very serious bottleneck. I think the answer is we must work harder to recruit them and we are working very hard now, but perhaps most of all we will have to find another method of obtaining skilled staff by way of training those whom we have and upgrading those we have. I think Dr. Fellegi has an observation.

Dr. Ivan P. Fellegi, Director, Sampling and Survey Research Staff, Dominion Bureau of Statistics: I think part of the answer to the question of Senator Grosart lies in making more use of the data we have already collected. When new information is required it sometimes takes a new survey or some new collection procedure to satisfy it. At other times it could be satisfied and is satisfied by making more use of data already collected. In this respect of course, the developing technology in computer retrieval is becoming a very important factor. Up until very recently it has not been very easy to satisfy special requests, even when related to making a tabulation on data that has already been collected. It required special programming; it required special effort and it was particularly time consuming and, therefore, was not conducive to encouraging this kind of request to come forward in the first place. We certainly have not solved this problem, but it is on its way to disappearing. In particular, we are planning a very elaborate program to satisfy just about any type of user request for tabulation, for example special tabulations going beyond the published material arising out of the 1971 census.

Senator Lang: Mr. Chairman, I wish to address Mr. Duffett again. Is there any way that the bureau can overcome this deficiency, albeit of a transient nature at the moment, by purchasing information outside or acquiring it, say, from the United States or employing private data generators?

The Chairman: From the CIA?

Senator Lang: That would be very interesting.

Mr. Duffett: A more immediate source of information which involves a minimum of manpower on the part of the Bureau of Statistics is to use administrative records. A few years ago we used or obtained access to the corporation income tax returns. This made it unnecessary for us to ask for the same information from business forms under the Corporations and Labour Unions Returns Act of which I am also an administrator and it gave us immediate access to a tremendous wealth of information which already existed and which was not necessary to go out and

collect. The possibility of using administrative statistics such as health statistics, hospital statistics, sales tax statistics and things of this kind, is a very interesting one. In many cases they need to be modified a little bit. This requires the persuasion of those who administer them or the ingenuity of those who use them in the Bureau of Statistics, but it is possible ultimately to save a good deal of time and money by using data in this fashion. Initially, however, it requires a good deal of skill to study the precise administrative procedures and see what you can get out of them. You have in mind perhaps employing commercial firms to undertake survey activity for us?

Senator Lang: Yes

Mr. Duffett: This might be done. Perhaps Dr. Fellegi, who is very familiar with survey activity, private survey firms, will comment on this, I am not sure it would always be possible to maintain the sort of controls that we would like to have in order to get the data of an adequate quantity and quality.

Dr. Fellegi: Yes. Actually, the situation in Canada is not quite comparable to what exists in the United States with respect to the existence of large and competent survey organizations outside of those that exist within the federal Government in the United States. There are in Canada private survey organizations and on occasion we are making use of their services. A notable one is just in the books right now. The DBS has agreed to undertake a domestic travel survey and the way it will be handled is probably an example of the type of activity that you have in mind. The DBS is going to set up the survey and design the actual method of operation, the collection of the data, the sampling techniques, but the field work on the other hand is going to be contracted out to one of the private firms in this business who will be working under DBS's supervision and will be using DBS's standards. That is they will be working under contract that specifies that we have certain regulative powers concerning the standards that apply. There have been other examples of this kind.

Senator Lang: I was thinking rather in more sophisticated terms than that. I believe we are now starting to develop in Canada certain organizations that work on a very high standard and a more sophisticated area than just nose counting and I often think if you cannot hire into your organization the people that you want, very often you can contract for them in another, where they exist in another media and use their services that way. I am not saying it is a good thing in the long term and probably it is not. The demand seems to be here and very immediate. What avenues may there be to substitute for long-term results?

Mr. Duffett: This is very true and I think Dr. Fellegi can give you one or two examples.

Dr. Fellegi: Taking a survey as the brief indicates is a very complex activity and it has several phases. The example I gave you related to a particular phase of the statistical activity namely collection. We have utilized resources outside of DBS in other phases of the statistical activity as well. For example, analytical resources in connection with the census monograph series. This was a rather ambitious program to analyse census statistics and draw out the information that is inherent in them in a highly articulate fashion.

Consultants have played an important role in setting us on the road or at least giving us the kernel of the idea of another major development that we are now in the process of fully developing. This is the one I mentioned a minute ago, namely the information system that we hope will operate on the 1971 census data. There are several examples of this kind where, for a particular phase of the complex system, which a particular operation is, resources from outside of DBS have been utilized.

The Chairman: Do you use sampling techniques and surveys on a continuing basis outside of your labour survey?

Dr. Fellegi: Yes. Certainly the Labour Force Survey is the largest sample survey in the household sector. There are several surveys besides the household surveys, for instance, our Retail Trade Surveys. There are several other examples.

Senator Grosart: On this question of response, what I am trying to get at is whether in the future we can look to DBS as a source to which industry, universities or anybody can go, with some assurance of getting a positive response. This arises out of my reading of the act to set up DBS and the functions described in your chapter 3, where everything seems to be oriented to serving Government. It speaks over and over again about the relationship of the Bureau to other departments, but nowhere do I see in the functions set out in the act, or your own description, any indication of assumption of responsibility to respond to requests.

The reason I think this is important is that we have nowhere else to go. DBS is the biggest establishment of its kind in Canada, and nothing is comparable to it. I am not in any way being critical. As a matter of fact, very recently, in response to a request of a friend of mine in the government of one of the developing countries, I sent him your catalogue. He wrote back saying, "I am sorry you sent us this, because we have enough problems already, without thinking we have to get up to this level of sophistication to run our country."

As I have said to the Chairman in private conversation, I think our Dominion Bureau of Statistics is

comparable in efficiency to any in the work. That is my own personal point of view. However, I am concerned as to whether in the future you see the DBS assuming a larger role in this general request for research information coming from other than Government departments. Is this a proper function for the Bureau, or do we have to say we have to find somebody else to assume this function?

Mr. Duffett: In part, this report may have misled you. This report presents only a partial view of our activities. We attempt to analyze those things with large research content and, inevitably, a great deal of what is called and generally recognized as research takes place in Government or universities. The business community does a good deal of applied research, and services to the business community, I think, are perhaps much larger than you may realize. The Bureau provides business oriented services to a greater extent than any statistical agency I know of, other than the American.

In December I spent some time in the British statistical office, and their greatest preoccupation was to find out from us what we do in serving the business community, because they feel they have failed rather seriously in this respect.

In terms of *ad hoc* service to business firms, which are mentioned earlier, one important thing I should perhaps repeat is that in the past we have been a little inhibited in doing this because the revenue derived from such services to businesses went directly to the Receiver General and did not remain in the Bureau in order to strengthen our resources.

This situation is in the course of being changed, and a revolving fund is being set up by Treasury Board, out of which we can draw money to hire additional staff, if we can find them, to do special jobs for the business community, and into which revenue from these jobs can go.

The fund will be about \$1/4 million to start with, but there is no reason why it cannot be extended, if this is necessary. It is simply a working capital fund. I hope this proves to be a very useful instrument, just as you do.

Senator Lang: Somewhere in your brief I think it was mentioned that you are unable to cost your own services.

Mr. Duffett: At the moment.

Senator Lang: It might be rather difficult to charge for your services if you are not able to relate them to some formulation of your own costs.

Mr. Duffett: We can cost our services in an elementary sense. We can measure the direct cost of the services we provide, and this we charge. The costing

system will become a more successful one as it become more necessary, say, with costs which emanate from the computer room, the tabulation, the tabulation facilities, and so on, and can be broadened to give information on any one project and identify it.

If one is going into this on a big scale you have to have a good costing system. We obtained the services, for a period of three months, of one of the officials of the Norwegian Statistical Office last year. Was it three months?

Dr. Goldberg: No, one month.

Mr. Duffett: Well, it seemed much longer! They have a sophisticated costing system. He worked very closely with our people, and I think it will be operating before very long.

Senator Grosart: I imagine the business community would understand if you worked on the principle of charging what the traffic would bear.

Mr. Duffett: One could perhaps take the direct cost and add 50 per cent for overhead.

Dr. Goldberg: The business community also contributes to DBS. There are many series based on information supplied by business and we have to take this into account so that we could not charge them what the traffic will bear.

Also it can be argued it is an important contribution of Government, through making more information available, as you implied a while ago, to render business more productive.

All I am trying to say is that there is a balance here. In some areas charging appears to be justified, and in others it would not be.

There is one point I would like to add. It is frequently difficult to charge for our services because many of our statistics are used by a variety of institutions at the same time. For example, it is the federal Government that gave us the mandate to develop employment and unemployment statistics, income and expenditures statistics, and so on. But I would like to make the point that now these statistics are also used by many others—the business community, other governments—and consequently in order to develop these series we had to initiate many new surveys, otherwise we would not have good overall figures.

The Chairman: And change many of your previous operations?

Dr. Goldberg: And change many of our previous operations. So, it is very difficult to say just because this particular business has asked for certain information, we should charge them, when most of the costs had to be incurred anyway.

Senator Grosart: I was thinking really in terms of response to a specific request.

Dr. Goldberg: Yes. Where the information is used specifically by a particular institution, and has very little general use, I think this is where we are planning to charge, in instances like this.

Senator Grosart: The obvious question is what is it worth to you.

Senator Lang: I have a lot of business clients wanting to charge DBS for filling out all their forms.

Mr. Duffett: We are aware of this too. This is one advantage of a central statistical office. It has higher awareness of the burden imposed on respondents and is enabled, by one means or another, to try to diminish this burden.

One important element of the contact we maintain with the provinces is to convey to them our own much longer experience about the obligations we have to the business community and to do everything we can to keep down the burden. May I add one statistic to comment on your query about services to business? It is noted in the brief that during a recent period we kept track of requests for information. In a period of three months we provided 1,700 letters in response to requests for information, and approximately half of these were requests from the business community. Over and above this there was a much larger number of replies by telephone and replies to direct inquiries.

Senator Cameron: I would like to come back to this matter; this committee is charged with the responsibility of formulating policy and we know as a result of rapidly changing and rapidly evolving technology universities are offering many new courses that they were not offering five years ago. In view of the critical role that effective statistics are going to play in the decision-making process for both government and business, would it be your view that it would be helpful if you or the Government of Canada or this committee were to recommend that some university in Canada be charged with a special responsibility for providing a course specifically designed to provide these skilled people you are looking for? For example, all of us who have gone through university have been exposed to courses in statistics of one kind or another, in biology or in economics, but those are not the kind of statistics we need today. So would this be practical if we were to say "All right, the criteria for people to go to do a course of this kind would be that they must be knowledgeable in specific fields, in interdisciplinary fields," and would we be justified in asking a university to provide this course? It may be a one-year course, or a semester course specifically designed to train people, highly skilled people that you want. Do you think this would be a practical recommendation for a committee like this to make?

Mr. Duffett: It might be. I find difficulty in seeing what this course would contain. Would it be a course in computer science, sampling or mathematics? This is my problem.

Senator Cameron: If you want a course on computer science, you can go to Carnegie Tech or some place like that and get the people there. But how do you use these tools to get a geologist or an energy resources man or an additional statistician? He needs to know how to use the tools that are available today. Would it be advantageous, for example, to do whatever is possible to stimulate a variety of closer contacts within the Bureau of Statistics and the universities, an arrangement by which university staff and graduate students could to an even greater extent than now do some work in the bureau during the summertime or for an extended period on contracts. It seems the message might then get through to a greater number of university people.

Senator Grosart: There might be a tremendous development in the very area Senator Cameron is suggesting, comparable to the training in librarianship, for example. This is an area which would not appear to have the demand comparable to that for statisticians, and yet there are courses given at universities that lead to a degree in librarianship. Is there any degree in statistics given by any university in Canada or the United States?

Dr. Fellegi: May I just before answering your direct question make a general comment in connection with Senator Cameron's question? Yes, indeed, there is a need for the generalist, but more and more, as has been mentioned previously, the direction in which our activity is developing is the fostering of highly competent specialist work in an interdisciplinary fashion. A generalist is a very important catalyst to keep them working together and to guide the overall development, but by and large we really want the best in each of the specialized fields to make its proper contribution to the overall project. I don't think it is possible to achieve this in any other fashion but by working together and by making the specialized fields work together towards the accomplishment of a given task.

Senator Grosart: Why would that be so? After all we require a plumber to take a seven-year course in apprenticeship.

Dr. Fellegi: Certainly.

Mr. Duffett: This relates to the second point and that is the question of degrees and statistics and the nature of the training.

Dr. Fellegi: So far as degrees and statistics are concerned there are some universities which give explicit degrees in statistics. They tend to be more oriented

towards the analytical use of statistics rather than the production of statistics. For example, there are very few universities in Canada which have a fully developed curriculum in sampling techniques which we use very extensively. This is slowly changing. One of the prerequisites of a good course, for example in sampling techniques, is the existence of some organization attached to the university which actually takes samples. There is only so much you can learn from books, and it is an important foundation, but then you really learn your craft by doing the work, and, as I say, this is very slowly changing, but there are signs of change. I can be more specific if you wish.

Senator Cameron: Relating to this, Mr. Duffett has said they are not too constrained by financial scarcity at the moment, which is a most unusual situation in government circles.

The Chairman: They have a good lobby.

Senator Cameron: But if that is the case would it be helpful if your department were to say—"All right, we are setting up a summer program of six weeks, or something like that, in which we can employ and pay a number of people who have specialized in various disciplines in the university and who are interested in going into the statistical field and who will come in here on a summer assignment and do this kind of specialized work under our department."?

Mr. Duffett: I think we have something like this which could be extended. We have an arrangement whereby during the summer we have hired university professors to do particular jobs and we have an arrangement whereby students in their final year, or just before their final year, are selected by heads of departments and sent to the Bureau of Statistics for work during the summer. However, we can only accommodate so many because it is important that they should have proper supervision. But those who are chosen are given special treatment and given every facility, including lecture courses, to explain to them what is going on in the organization and in fact to attract them to the organization.

We do not ultimately receive all of these people back as employees, but they perform a useful service in the community at large because they are familiar with the bureau. I do not recall how many we have had in recent years, but something like 30 people. There is a limitation in terms of giving the attention to which they are entitled.

Dr. Fellegi: Mr. Duffett, may I make an additional observation in this respect. As has been mentioned before the statistical process is a very complex one and there is only so much that can be transmitted of this complexity in the form of training in the course of a short summer period. The other point in connection

with this summer program is that some of the summer students do tend to come back for next summer and the following summer and gradually acquire a little more of the knowledge, but then many of them do not. We do have an arrangement now with one of the universities which has a program of alternating academic and on-the-job training; one semester on the job and one semester academic. We are taking advantage of it and we hope we are contributing, by so doing, to the students who participate in this type of activity. I think it is an ideal kind of arrangement for this particular type of learning process. We do have courses in the bureau to supplement the training of our graduates, when they arrive on the job. For example, we have a very fully developed course in the field of sample survey technology and methodology whose level is equivalent to a post-graduate course but without, of course, giving credits.

Probably about 40 or 50 people have taken this course in the Bureau, graduates who arrive without this requisite for their work.

Senator Grosart: How many students would you say at the present time were taking courses in Canadian universities that would fit them to some degree to meet the requirements of manpower shortage that you spoke of?

Mr. Duffett: May I reply to that?

Senator Grosart: I should say, do you have that statistic?

Mr. Duffett: The figure would be a very large one, because there are a large number of people taking economics courses. A significant number of people are taking courses in mathematics and statistics. Our principal problem, however, at the moment is not employing people who have an undergraduate degree, but of obtaining people who have rather higher skills and more experience. This is the current bottleneck as I said earlier, and it will always be a bottleneck at one time or another.

Senator Grosart: Of course, everybody has this problem. Every business has the same problem. You take people out of universities and they have a background of training and your job is to apply that training to your particular needs and in whatever form your business requires. Would you say that the number of students now engaged in these courses is adequate to meet the demands of the future for statistical research?

Mr. Duffett: It is reasonably adequate to meet our demands for that kind of person. There are people who come to us for undergraduate training.

The Chairman: Then there remains the question of separation. Have you studied this and seen what were the different factors which came into play?

Mr. Duffett: We have a certain turnover. I think the image perhaps people have in their minds of recruitment activity of the bureau is not quite right and there are some tables in the appendixes here that are quite interesting in this respect. About half of our acquisitions in recent years have not been directly from universities, but from elsewhere and from people who come to us from other Government departments or business firms. Therefore, we are not entirely dependent upon universities as a source of manpower.

The Chairman: What about those who are leaving?

Mr. Duffett: There is a certain turnover. I think a certain turnover is inevitable and I think the turnover contributes something very useful to those who receive the people who have been in the Bureau of Statistics. Looking at it from a short-term point of view we are unhappy about the turnover. We have to reconcile ourselves, as other departments do, for the turnover. The turnover in other Government departments comes to us.

The Chairman: Is it related to deficiency in the salary structure or the nature of the work of the bureau?

Mr. Duffett: From time to time I think it is. I mentioned in my introductory remarks that a certain amount of research activity in the organization is important in order to attract and retain certain types of people. In some cases I think the salary principles of the federal Government cause trouble. At the upper levels or the very high levels of research skill, people are attracted away from research and into administration and occasionally we do lose people who are excellent researchers, but who are attracted by salaries and other departments in business.

Senator Lang: On the same line of questioning, Mr. Chairman, I have the layman's impression that statistics, divorced from the reason for developing statistics or the evolution or a solution of problems—I have an idea, if you divorce one from the other, statistics in itself is a very dry, rather uncreative realm to be working in and I am just wondering if it is possible...

The Chairman: You are speaking as a layman now.

Senator Lang: I am speaking as a layman, but I am wondering if perhaps that general impression of lack of creativity because of the divorce of the bureau, say, from the people who it is serving, tends to inhibit a man of a broad creative outlook from staying in the confines of the bureau as opposed to doing that type

of work directly connected with the people who are involved in the policy or the end result.

Mr. Duffett: This is a consideration and I think some of the people who leave the bureau are attracted by the fact or the illusion, that if they go elsewhere they will be intimately engaged in high level policy making. I think we have to anticipate some turnover for this reason. I do hope that within the bureau, and I think we have achieved it to some degree, we can provide a sort of interesting activity that people of that kind enjoy. I mentioned earlier that we have a research activity in a number of fields.

The volumes which were produced in connection with the census monograph series of the 1961 census were of a type which will I think tend to keep people in the Bureau of Statistics. It was a straight research job, and a good research job, that went into these monographs. The problem you describe does exist.

Senator Lang: To go back to where we were in the beginning, you mentioned the advantages of having a centralized statistical agency within a government as opposed to having it divided according to function amongst various departments. I am just wondering, related to these alternates, this one problem might be less significant in one form of organization than it is in the present one.

Dr. Goldberg: If I may just say a word. Senator Lang, you asked awhile ago what the situation was in the United States and the United Kingdom. Our colleagues in the United States and the United Kingdom that operate substantially in the kind of milieu you are pointing to, have similar problems to our own.

In the United States, for example, I know that the Department of Commerce, the group that does the national income work, has great difficulty in retaining people simply because it is a fact, I think, that the activity of using information appears to be more glamorous than the activity of producing information. To some extent it is a matter of taste, but to some extent it is the result of the fact that the intellectually challenging activities involved in the production of statistics have not been sufficiently featured, and this is where I come to Senator Cameron's and Senator Grosart's remarks. I think the Canadian community is going to benefit a great deal the closer we come to the universities. The universities will benefit too because it will inject an empirical orientation into their courses. We will benefit through first-hand experience; the students and professors will see how, in the age of the computer, the challenge of producing flexible, quick information is intellectually a very high level one. So, there are both these elements involved. It is not a matter of organization sort of interdepartmentally, but rather a matter of using our resources

and strengthening our relations with the sources of knowledge and training.

The Chairman: Do you feel there is a lag, as far as your requirements are concerned, in university teaching?

Dr. Goldberg: I will express a personal view.

The Chairman: I do not want you to get into trouble with the academic community!

Dr. Goldberg: I can afford it now! I think that to some extent the social science teaching in Canadian universities has not been as integrated with government activities and needs and general community needs as, say, in the United Kingdom and the United States, in particular, where there is a much closer relationship. This, in turn, has a great deal of feed-back into the research programs. I think this is true, and, as you know, the Canadian universities are growing, but relatively few universities will give as yet a Ph.D. in social science, in economics, sociology and statistics. Many Canadians who want to aspire to the higher level degrees find themselves going to the United States and the United Kingdom, so there is this fact.

On our side of it I think there is a problem from this point of view as well. You can use a man, a good man, to produce new information, new ways to make information more flexible. We describe in the brief a few of these projects which will go quite a distance, when they are completed, towards satisfying more quickly and flexibly the demands of business as well as Government. I refer for example to the geographically automated system and the time-series data bank. There are these developments with in our own organization. We have our own internal teaching, not nearly enough, but we are hoping to do a little more. There is a program of summer students, and programs to involve university professors and graduates in the actual process of statistical production. We hope that the challenging aspects of statistical production will become more clearly recognized through this. We also hope that through this the universities will inject into their curriculum an orientation in the student that he should try to do practical work within an organization such as the Bureau. Even if he does not stay more than four or five years, this gives him a very good background for work in other organizations. In addition the teaching courses should use the actual information that we have produced. They do this to quite an extent, and I think it could be done more.

Senator Grosart: I agree generally with what you say about the necessity of glamorizing the discipline. I have a daughter finishing a course in statistics and she said, "What is the use of all this?" I said, "There are all sorts of uses. For example, I use statistics when I make speeches." She said, "But, daddy, you don't have to be exact!"

The Chairman: She knows you pretty well.

Senator Grosart: About all they did in the first year was to frighten her; and when I have looked at some of the textbooks I have been a little frightened too, and I have been a little less free with statistics since.

You mentioned the time series data bank. I understand you are putting some of the accumulated research statistical information on cards.

Mr. Duffett: On tape.

Senator Grosart: Is it on tape?

Mr. Duffett: Mainly on tape.

Senator Grosart: You are doing part of the computer programming system for business and others to make use of. Where did the initiative come from for this? When and how did you decide on this service? When did you say, "We have all this information; we should now move it one stage further so it will be more useful and more available to the business community and others"?

Mr. Duffett: I can answer that, or can I ask one of my colleagues, Dr. Vander Noot to speak about it?

Dr. T. J. Vander Noot, Associate Director General, Operations and Systems Branch, Dominion Bureau of Statistics: This question of development initiative between government agencies and the Dominion Bureau of Statistics, I think, is a very crucial one. Most of the really important user-oriented type systems tend to be developed by someone who is working in a more glamorous analytical area suddenly discovering that all his problems are measurement problems, and since he needs more and more data for his own uses.

The time series data bank started basically about four years ago in the Economic Council, with a young econometrician who got needed to produce machine language records every time he wanted to make some change in his econometric model. He wrote a general purpose storage program. This program worked excellently and has been in use in DBS, in the Economic Council and the Bank of Canada since that time as a manipulative package. However, as is the case with many other things, a good thing breeds its own seeds of disaster, if you will. More and more data were required by a growing number of governmental researchers so that the system became unwieldy.

About two years ago the Economic Council and the Dominion Bureau of Statistics co-operated in an attempt, which has been highly successful, to construct a system whereby virtually all publishable time series data that are available in the Dominion Bureau of Statistics could be put in a readily accessible form. This particular work has been completed now, or at least the construction of the programs is completed.

We are a long way from getting all of the data we want into the storehouse, if you will. But this is how it came about, and now it is a matter of taking the time and the trouble to clean up the few discrepancies that exist always in the data and getting them into the storehouse in the proper form.

When this is done we will make basically two kinds of services available. One is what we are calling, for lack of a better word, the "standard package", about 5,000 time series or 7,000—it keeps varying from day to day depending on who is requesting the latest block of data, which will be available monthly on tape at quite a reasonable price. These are the 5,000 most commonly used series and are covered by the data included in the Canadian Statistical Review. The second function of the new system relates to the thousands of time series that could be published by the Dominion Bureau of Statistics if it were not so expensive to produce a publication. We are converting, as fast as we can, all of the data into the same format so that it can be used by manipulative and statistical programs. Or in the case of your own illustration to be able to pull out the employment statistics for a specific township. This type of data should be easy to find, but it is not now since it requires reference back to the original source documents or ledgers.

Senator Grosart: How universally applicable will this program be having in mind the different computer systems in use?

Dr. Vander Noot: I think the analogy of a storehouse is a very good one in that we will be putting data into the storehouse so that it can be retrieved in a common format. This storehouse will have to be resident on Dominion Bureau equipment because there are confidential series in there as well. However, we can pull out either the standard package that I mentioned or any special statistics that you wish in a format which can be used on virtually any machine. And there is now a set of manipulative programs where a university, for instance, who wants to use this data for experimentation or for teaching purposes can buy the standard tape from the Dominion Bureau of Statistics. The other day we came to an agreement with the Bank of Canada whereby the Bank of Canada will supply the manipulative programs so that you can do virtually anything with it that you want.

The Chairman: It is 20 past 12 now and we have to deal with the two annexes, and I would suggest that we should adjourn by a quarter to one to have a brief *in camera* meeting. I think while it is up to the committee to allocate this time, I presume we would want to ask some questions also about the two annexes.

Senator Grosart: I have one question, and I may be using "time series" here in a different sense to the

reply we have just heard. Are you doing any work on improving the validity of time series statistics, that is filling in the gaps in the past?

Mr. Duffett: Yes. Filling in the gaps in the past is a difficult task because the series as they now exist usually reflect most of the data which is available for the purpose.

Mr. Goldberg: As I understand the question it is are we planning to add to the available information such as price, income, employment, productivity and so on.

Senator Grosart: I am not suggesting the new fields. But are you improving the validity of the existing statistics?

Mr. Goldberg: Yes.

Senator Grosart: The Bank of Canada told us they were not too interested in this because theirs is an operative function and they are concerned primarily with current trend statistics.

Mr. Golberg: Well, there are two aspects here. As the new information becomes available we try after an interval of time to incorporate it into the available series. Perhaps the most prominent example now is the review being completed in connection with national income and expenditure accounts. We completed a revision of an index of industrial production a couple of years ago. There is that aspect of improvement utilizing information not available initially but which has become available now. The other aspect is how far do we go back in time to develop information? For example, from 1900 to 1920?

Senator Grosart: That is my question.

Mr. Goldberg: As far as that is concerned there are two schools of thought, both equally reputable. One of them is headed by Simon Kuznets of Harvard, who has for many years persuaded quite a number of social scientists that unless you do a great deal of research extending backwards you are not going to be able to make a good prognosis of the future, because there is an underlying belief that history repeats itself although differently. The other school feels that because history repeats itself so differently the new developments should be studied and if you want to look into the future you will have to have more information on the current—and by current I mean the last quarter-century or so. I won't tell you what school I belong to, but I will say that the pressures on the bureau are overwhelmingly in the direction of satisfying the more current oriented school. Where, as we indicated before, we have scarce resources we have to make choices and so far the choice has been that we should not undertake long historical studies if that is to be carried out at the expense of important current work.

Senator Grosart: The reason the question interests me is that I know a great many people who really believe that land values are going to continue forever to go up. I keep reminding them of the time when the banks were not allowed to put any public money into land because this was speculation. I think there is some importance in increasing the validity of the historical series even if it is only to remind people that history does repeat itself, particularly in the economics sphere. Our economists are always telling us about "cycles."

Dr. Goldberg: I can see what school you belong to.

The Chairman: He is both in the past and the future. He belongs to two schools.

Senator Yuzyk: I have a question regarding DBS and research work requested by research institutions or universities. How far is DBS prepared to meet the demands of research departments in various universities for statistics, elementary statistics first of all and perhaps some of the more sophisticated statistics which require analysis and so forth?

I am involved with ethnic groups in Canada and I have been studying the statistics as published. I have not always been satisfied with these statistics, because it is not always adequate. I have had to phone in and get certain information and wait sometimes two weeks before I really got an answer. Is the Dominion Bureau of Statistics prepared to co-operate—some of the universities are establishing departments of ethnic studies and will be establishing them—and meet some of these demands and even produce statistics that have not been published so far, and using techniques to get information about the various ethnic groups for complete sociological study for at least some of the larger groups.

Mr. Duffett: What you are interested in is census information.

Senator Yuzyk: Yes.

Mr. Duffett: It is difficult to say either categorically yes or no. In these situations we are once again up against priority matters. The census can have only so many questions on it. The 1971 census looks as though it is going to have significantly more questions on the form than was the case in 1961, which was the last large census.

There comes a time when the public simply gets tired of answering questions and we necessarily have to look at each request individually to determine what the material is going to be used for and how seriously it is needed and what effect it will have on response. That may seem to be a rather general answer, but this is the process that we have to go through.

Senator Grosart: Didn't you have a specific problem in connection with the last census relating to a question in "country of origin"? I seem to remember there was some political or sociological problem.

Mr. Duffett: We had proposed a question on origin and the purpose of it was to find out the source from which the Canadian population originated abroad. It was suggested to us, however, that it should be made desirable to accept "Canadian" as an answer. This eventually got changed back.

Dr. Goldberg: May I add something?

Senator Yuzyk: I still did not get a reply to my question.

Dr. Goldberg: I would just like to add that there are two points. One is the geographical computerized data bank which is described in our brief and will make it possible for the bureau to provide much more information by small areas and individual characteristics of people so our capability for handling requests will be greater. Secondly, in line with the previous discussion we are planning two activities which we hope to develop if we get the support from the Treasury Board; if we get the finances and resources. One is to initiate after the 1971 census a current regular survey activity in addition to what we have now through the labour force survey. The labour force survey facilities are overtaxed and it is quite clear to us, in the light of the many demands that have accumulated in the last few years, we have got to expand this sort of activity very substantially and this will enable us, if we succeed in doing that, to respond more readily to new requests when they have been evaluated as being of high enough priority. That is one important activity which will strengthen our capability to reply. The other one, and the one Mr. Duffett has mentioned several times, is that we are hoping to do much more research and analysis so that we can understand better this sort of request and perhaps respond not only in terms of figures, but in analytical form as well.

Senator Yuzyk: I am glad to hear this because I think this is sorely needed in this stage.

Dr. Goldberg: As Mr. Duffett said, we are not the masters of destiny. It will depend on how the Treasury Board reacts to our requests.

Senator Yuzyk: Just another supplementary question. If a research body was set up outside, say the university, but still interested basically in research and the promising results of research, would the DBS chart for requests require research on the part of your own specialists in order to produce certain material?

Mr. Duffett: It would depend. Generally speaking, I think we would find it necessary to make a charge.

The charges are not likely to be very large for the amount of data.

Senator Yuzyk: What about the cost?

Mr. Duffett: There could be circumstances in which it was evident this was a matter of very widespread public interest and in circumstances such as that, we would consider producing it free for publication.

The Chairman: I think we should come to the annex, which I suppose is of direct and special interest to the committee. Are there any questions about Annex A which deals with the present surveys regarding scientific activities? It seems to me there are two problems in this field that you fear at the moment. First of all, you are not doing enough and the second one is probably the growing lack of co-ordination. This growing lack of co-ordination is appearing to us as we proceed with our hearings. The Science Secretariat is collecting data.

Mr. Duffett: You are referring to the research in the social sciences?

The Chairman: No, the scientific activities also. I think it applies to both. The planning secretariat of the Privy Council has been collecting data, very little of course, but on Government grants to university people, and we see this kind of dispersion of effort. It seems to me that perhaps very often everybody talks about co-ordination, but it is not realized, and if there were greater centralization in DBS for that kind of effort it might mean not only a saving of money but perhaps also a better effort.

Mr. Duffett: It is not difficult to see why in a number of cases—and I do not think there are yet exceedingly serious—other bodies have felt it desirable to conduct surveys in the physical sciences and, to a limited extent, in the social sciences, since we were not in all cases able to satisfy their needs. In both cases we contemplate assigning additional resources to this work. Particularly in the case of the physical sciences the Bureau conducts the major survey, and with some additional resources and more timely statistics, particularly in the case of industrial research, the problem may not be as serious as it has been in the past. I do think, however, we should undertake a rather more formal system of co-ordination. As the report says, the co-ordination up to this point consisted very largely of personal contacts between Mr. Leclerc and people in the National Research Council and elsewhere. I think this needs to be formalized and made a little more affective.

Senator Grosart: Would you explain the meaning of the statement on page 19? It turns on this particular question and the very question you asked, Mr. Chairman.

These duties envisage a high degree of centralization of statistical activity and authority within the federal Government.

Does this mean within DBS?

Mr. Duffett: Yes.

Senator Grosart: Are you satisfied you have achieved that degree of centralization?

Mr. Duffett: No, I think some improvements could be effected in this direction. But there is very little statistical activity that goes on in the federal Government in which we do not either undertake or participate in some sense. I think it is desirable that certain activities should take place in Government departments, particularly when they are related to the administrative activities of the Department.

The Chairman: In this field of measuring scientific activities the Science Secretariat is undertaking elaborate and detailed inventories in certain fields.

Mr. Duffett: In the physical sciences.

The Chairman: Or in the life sciences. They spend a lot of money in producing these inventories, but there is no follow-up. With the rapid change which is occurring in this field now, these inventories become obsolete very soon and there is no follow-up. Therefore, the money being devoted to this, it seems to me, is to a certain extent at least largely wasted.

Mr. Duffett: I think these things should be on a continuing basis.

The Chairman: The Macdonald study, have you contributed to this, or are you arranging that when this report is being published you will follow it up?

Mr. Duffett: Not at the moment. I think perhaps Mr. Leclerc could answer your question more effectively.

Mr. J. G. Leclerc, Director, Business Finance Division, Dominion Bureau Of Statistics: I think I can only make a general comment. In the past ten years there has been an increasing interest in all these matters. It is quite true that the amount of co-ordination so far has been based on personal relationships, and they tend to vary from time to time. However, in the past two or three years there has been quite a sudden increase in interest, which was translated in the federal Government by the formation of the Science Secretariat, followed by the Science Council. The Science Council and the Science Secretariat felt the need, in order to fill their own commitments, to start making inventories of the various fields of science, like mineralogy, water resources, and so on.

The Chairman: Physics?

Mr. Leclerc: Yes, physics and so on. Obviously, this must have been the result of a very widespread interest in the scientific world as well. The Science Secretariat was in touch with a lot of people in the scientific community, and they felt they were in a position to attract people to start working on these various problems.

On the other hand, there may have been an impression that the Bureau was not quite ready at that time to undertake such a huge task. We are not specialists in any of these areas, and we did not take the attitude that if there was going to be a survey it should be made by us.

I think the state of the art being what it was, say, two years ago and last year, it was necessary to have even rough inventories made by specialists who would not have to take three years to learn the subject matter. What we were hoping was that once they had decided the kind of information they wanted to have, they should involve us in not necessarily a co-ordinating role, but in a capacity whereby we would be in a position to explain to them our programs.

We have been after large aggregates in terms of expenditures, manpower, and so on. We have not been after inventories of projects, by title of projects, to find out whether one may be better served than another, although we have questions relating generally to these fields, areas of application, and so on.

There are some surveys the Science Secretariat contracted out. People came to see us, and we discussed various definitions and the general framework, and some of them did adopt our own framework. In other words, they were starting with what we had and were getting down to more detailed questions. In some such cases, as a matter of fact, we even agreed to look after certain operational phases, like drawing up mailing lists, mailing the survey, receiving it and doing certain follow-ups. In some other cases people who had a contract from the Science Secretariat came to see us. Maybe it was symbolic gesture! We told them what we did, but it might have taken the form of disregarded advice. So the whole thing is very uneven. All those who have adopted our framework we can follow up, but the others we cannot.

Senator Grosart: There is a question here, whether with this "unevenness," as you call it, or the "stop and go" characteristics of our present statistical inventory building, we may be creating more gaps for somebody in the year 2000 to worry about than we have to worry about for the 1900's.

I bring this up because you have emphasized the centralizing function. I am by no means a centralist, but is there not at the moment the lack of any entity

charged with the full responsibility of centralizing and regularizing the statistical inventory?

The Chairman: Is this generally or specifically related to the scientific effort?

Senator Grosart: Naturally, to the scientific effort, but all statistics are part of the total scientific decision.

Mr. Duffett: I think Senator Grosart is quite right. The Statistics Act gave us the responsibility for co-ordination without powers.

Senator Grosart: Good, I will quote that in the report.

Dr. Goldberg: I would like to add that when it comes to the specific social sciences and other science surveys, as far as I know DBS has not been given a mandate to carry forward this field and give it the priority some people feel it deserves and that we have been given in other fields, income, employment, productivity. There is no clear-cut mandate.

Senator Yuzyk: That depends on the demand, does it?

Mr. Duffett: It depends on the source of the demand and the way in which the demand is articulated. If a body such as the federal Government indicated specifically that they wished us to take a co-ordinating role in this field, we would be happy to do it.

The Chairman: I am sure we will have a lot of other questions, but it is already a quarter to one. Before we end this meeting, I would like to remind you, Mr. Duffett, that you offered us at the beginning of your opening remarks to organize a small crash program to at least give us some indication of the information which is available in the field of the social sciences. Do you think this would involve a lot of work, and how long would it take?

Mr. Duffett: I cannot tell you. Most of all it would involve getting one or two people to do it, and we should consult with your own research group on what kind of information they want, and what definitions they require and whether they have any ideas regarding an individual they could recommend. As I mentioned earlier there is still another approach and that is that Mr. Stead, who is here, has formulated some views as to the probable magnitude of research in social sciences. He has a figure which one would scarcely regard as a statistic, but he might give some idea of what the magnitude would be.

Mr. H. Stead, Chief, Scientific Activities Surveys Section, Dominion Bureau Of Statistics: Well, I have made a comment in a paper which I have entitled "A Few Guesses about R & D Expenditure". The title indicates the reliability of the estimate. Just looking at the federal Government for a moment—

Mr. Duffett: Perhaps you might just supply us with the total.

Mr. Stead: There might be \$25 million or \$30 million expenditure on social science research excluding the business enterprise sector, about \$20 million on the part of the universities and \$5 million to \$10 million on the part of the federal Government.

The Chairman: Would that include grants of the Canada Council?

Mr. Stead: Yes.

The Chairman: We will come back to this later and ask our staff to keep contact with you. I want to thank you, Mr. Duffett, and your colleagues for being with us this morning.

The committee adjourned.

APPENDIX 25

DOMINION BUREAU OF STATISTICS

BRIEF
TO THE
SPECIAL COMMITTEE
ON
SCIENCE POLICY
SENATE OF CANADA

DECEMBER 1968

DOMINION BUREAU OF STATISTICS

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PREFACE

This brief, prepared by the Dominion Bureau of Statistics, is divided into three parts:

Part I contains an introduction and a summary of the whole brief;

Part II contains material discussing in greater detail the points summarized in Part I;

Part III contains appendices providing supporting material for a number of topics included in

Part II.

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December 28, 1968

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PART I

INTRODUCTION AND SUMMARY

CHAPTER 1INTRODUCTION

1.1 The Dominion Bureau of Statistics welcomes the opportunity of presenting this brief to the Special Committee on Science Policy.* The major portion of the Bureau's approximately 3,000 employees are, in one way or another, engaged in the production of information which is used in social science research, broadly defined. This information is, of course, also used by business, governments and others for policy, management and administration.

1.2 The Bureau is a major element of the information system upon which public and private institutions and individuals draw in studying social and economic conditions and problems and in making logical decisions. The importance of good information for research and decision-making has been recognized for many years but the demand for information has grown enormously in recent years as the need for research has become more evident and as methods of using information have become more sophisticated and effective. Some months ago the Chairman of the Economic Council of Canada, in an address on "Good Information for Good Decision Making" made the following statement:

"To a growing extent the modern economy is coming to run on knowledge and information which needs to be taken into account in economic decision-making at all levels--whether by consumers, by private producers and distributors or by governments. Moreover, to use this resource effectively in our modern society, the inputs cannot in most cases be raw or casual information. To be really useful, information needs to be an organized, a processed, a worked-over product. It must be in readily applicable form. It needs to be accurate. It needs to be available in a timely way. And it needs to be relevant to decisions. In short, good information is indispensable to good decision-making and to the efficient performance of a modern economy."

* As the Committee is aware, the Bureau produces statistics on research and development expenditures in the physical and life sciences. A separate memorandum on the measurement of research and development in the social sciences has been prepared by the Dominion Bureau of Statistics, at the suggestion of the Chairman of the Committee, to serve as a basis for discussion.

1.3 To an increasing extent, information has come to be used in numerical form. Information in this form is frequently preferred to narrative information because it is more precise, it is readily storable and retrievable and it is easily handled by business machines.

1.4 DBS statistics, which cover nearly every aspect of Canadian economic and social life, constitute the foundation on which takes place much of the research in the social sciences in Canada. However, by no means all of the users of DBS statistics are engaged in research in the social sciences, no matter how broadly the word research is defined. Many users are interested in information to keep abreast of current developments, such as those reflected by statistics on exports or the gross national product. Others use the data as an administrative instrument--for example, the consumer price index as an escalation factor in a wage contract. However, the same data, and in fact virtually all DBS data, are in varying degree used for research purposes, if by "research" we mean the examination and analysis of information to further understanding of institutional and individual behaviour. This research may take the form of very general studies of social phenomena, for example, by a university or a royal commission; or it may be a highly specialized market research project in a business firm.

1.5 The provision of statistics involves activities which fall under the heading of "Research and Development". In the first place, for the statistics to be significant and useful, thorough investigation and understanding of the subject matter fields to which the information relates are essential. Consequently, DBS officers must be knowledgeable in the fields in which they operate and keep themselves fully informed of significant changes. Secondly, the development of survey methodology and computer techniques calls for mathematical, statistical and technical skills of a high order among staff and line officers of DBS. The Dominion Bureau of Statistics as the major statistical centre in Canada, depends heavily on the skills and ingenuity of its own staff who engage in basic research, while

maintaining fruitful contacts with Canadian universities and with statistical agencies abroad. In addition, the statistical system itself must be studied and developed in order to achieve coherence among its constituent parts since, in effect, the various statistical series measure different aspects of interdependent social and economic phenomena.

1.6 The statistical process in DBS ranges from data collection to analytical and research work on the Canadian phenomena being measured. The latter not only constitutes a useful contribution to the social sciences as such but, by encouraging DBS officers to look critically at their own product, contributes to the improvement of the statistics. It is difficult, when demand for statistics is so insistent, to detach staff for subject matter research but this is done to a significant degree and it is the intention of DBS to extend it. Following the 1961 Census, for example, a series of major research studies were undertaken by DBS officers and by professors retained on contract by DBS. These have been well received and confirm the value of a research program in a statistical agency.

1.7 An effort has been made in this brief to cover, so far as they apply, the headings suggested in the Committee's Guidelines; however, it appeared desirable to follow a somewhat different order of presentation. The brief attempts to describe the structure, programs and activities of the Dominion Bureau of Statistics. In line with the Committee's terms of reference, prominence is given to research and development activities in DBS. A comprehensive, though abbreviated, review of the DBS subject matter statistical programs, to which the major portion of its budget is devoted, is also included. A review of DBS plans for the next few years is included, which is intended to indicate the direction the Bureau is taking. It was felt that such a review would be more useful than a series of recommendations.

CHAPTER 2SUMMARY REPORT

Functions, Organization, Personnel, Budget
(see Chapter 3 and Appendices 1 and 2).

2.1 The Dominion Bureau of Statistics, created fifty years ago by legislation referred to as the Statistics Act, is a government department under the Minister of Industry, Trade and Commerce. The functions of the Bureau as set out in the Statistics Act, are described in Chapter 3. The legislative authority to collect information and responsibility to maintain its confidentiality are essential elements in the operation of a statistical system. The Statistics Act has not been revised for many years and DBS intends to propose some changes to bring the legislation up to date.

2.2 The Dominion Bureau of Statistics, headed by the Dominion Statistician, is composed of four central management groups with Bureau-wide functions, a central information services group, and four subject matter branches, consisting of a number of subject matter divisions each of which is responsible for a broad range of statistical series in a related set of subject matter fields. DBS field work is carried out through eight regional offices located in various parts of the country, from Newfoundland to British Columbia.

2.3 The Bureau employs personnel with a wide range of skills, including those of the statistician, economist, administrator, manager, computer programming and systems analyst, sociologist, demographer, mathematician, and a variety of subject matter specialists. Moreover, DBS requires officers who combine some of these skills in varying degree. Consequently, DBS employs persons with university degrees in related disciplines whether they are primarily oriented towards research or other professional activities in the statistical process. Staff members with special skills in research are identified primarily through actual performance rather than on the basis of a priori criteria.

2.4 The advent of the computer technology, together with the requirements of users for more sophisticated statistics and analysis, are having an impact on the balance of human resources employed in the Bureau. The relative proportion of professional and technical staff has increased and is expected to continue to increase for some time.

2.5 The greatly increased need for highly trained professional staff, coupled with the severe shortage for such skills, confronts the Bureau with a difficult resource problem. In attempting to meet this situation, the Bureau is involving its senior professional personnel, to an increasing extent, in recruiting activity. Furthermore, greater use is made of semi-professional staff (the administrative and technical categories) to relieve, as much as possible, professionals for research and development assignments. While progress has been made in recruiting, the number of professionals has fallen short of authorized numbers by a considerable margin--94 less than the establishment of 514 professional positions, as at September 1968.

2.6 Growth of the Bureau during the last few years and the difficulty of recruiting experienced personnel are reflected in the fact that 60 per cent of its professional staff have less than five years of service with DBS.

2.7 Although the total number of professionals in DBS is relatively large, the range of skills which the statistical process requires and the scores of subjects for which the Bureau publishes statistics means that the number assigned to any one area is small. Constant pressure on small staffs has made it difficult to provide adequate attention to the development of human capital within the organization to cope with the increasingly difficult tasks of planning, analysis, research and automation. The evolving of suitable training and career development programs will nevertheless be getting high priority during the next few years.

2.8 The budget of the Bureau has grown from approximately \$12,000,000 for fiscal year 1962-63 to over \$27,000,000 in 1968-69. This growth reflects new and expanded or improved statistical programs; growth in the number of records requiring processing, reflecting the growth of the

economy; growth in development of automated facilities, and associated increases in computer programming and mathematical staff, with a view to raising output per man; growth in subject matter research and analysis and in more comprehensive integration of statistics; extensive testing and other preparations for the 1971 Census; increase in information services activities; more comprehensive requirements of management, administration, personnel and financial programs; and, of course, price and salary increases.

2.9 The increase in dollar expenditure was accompanied by an increase in staff from approximately 1,800 on April 1, 1962 to 2,800 on April 1, 1968.

The Evolving Pattern of Demand for Statistical Services
(see Chapter 4)

2.10 The demand for statistics has undergone a rapid evolution during the last 25 years. The need for expanding substantially statistical services was seriously felt as a result of the depression of the 1930's, the work of the Rowell-Sirois Commission, the economic stresses and strains of World War II and the exigencies of post-war reconstruction. A more penetrating awareness of "Keynesian economics" was another propelling factor. Following a period of relative quiescence in the demand for statistics during the 1950's, the extension during the 1960's, of government policies into new areas and the creation of a number of new government departments and agencies have resulted in a new upsurge in the demand for more, better and faster information as a basis for research, policy determination and administration. Another major source of demand resulted from the acceleration in economic and social policy development at provincial and municipal levels. Royal commissions and task forces, the expansion of university and independent research bodies and the extension and increased sophistication of business and market research have contributed substantially to this upsurge in demand. To meet these requirements other departments of the federal government have supported an expansion in DBS resources.

Some Developments in the Organization and Methodology of Statistics to Meet Growing Demands
(See Chapter 5)

2.11 The response of the Bureau to the massive demands for additional statistical information has been facilitated by certain improvements in the methodology of securing, analyzing, and organizing statistics. These improvements, however, have had the effect of stimulating the demand even further.

2.12 For most purposes a multitude of separately generated series on particular phenomena is not sufficient. Policy makers and social scientists alike are interested in the interactions and interrelationships between a variety of economic and social phenomena, all acting upon one another, often simultaneously. Accordingly, the statistical system must be developed in such a way as to achieve coherence among its constituent parts since, in effect, the various statistical series measure different aspects of interdependent social and economic phenomena. The national accounts statistics developed in the Bureau have made a major contribution to the development of an integrated system of economic statistics as well as to the study of economic policy and research. The process of integration of statistics has also been facilitated greatly by development of consistent systems of industry, commodity and other classifications which are essential for the development of comparable data.

2.13 Another major contribution to the accumulation of statistical information has taken place in the area of survey research. In particular, the development and application of mathematical theories of sampling and of other survey methodology have opened up new frontiers of statistical data collection and processing. Furthermore, the computer technology is increasing substantially the Bureau's capability for producing information.

2.14 However, the demands for statistics have been growing faster than the Bureau's increasing capacity to meet them. Accelerated automation will reduce this gap but a severe limitation in achieving such reduction quickly is a shortage of trained professional and technical staff, as indicated earlier.

The Output of the Dominion Bureau of Statistics
(See Chapter 6)

2.15 The most tangible and visible output of the Dominion Bureau of Statistics takes the form of regular statistical reports numbering well over 500 plus over 200 occasional publications, including special studies, monographs and manuals of industry, commodity and other classification systems. In addition, there are 400 publications covering the results of the 1961 and 1966 censuses. Many of the regular reports appear monthly, quarterly, as well as annually, and altogether well over 1 million copies of reports, including the Canada Year Book and Handbook but excluding the daily and weekly bulletins, are distributed in a year. A considerable volume of information, including special tabulations, is released in response to inquiries. There is also a very large secondary distribution through reprints of DBS information in newspapers, trade journals, and so on. A great deal of DBS material is built into research studies and books.

2.16 Machine-readable data in the form of computer tapes are also issued and this form of output will increase in the future. The Bureau expects to make available in the spring of 1969 a time series data bank which will consist initially of some 7,000 non-confidential statistical series in machine-readable form, each extending over a period of years. As time and resources permit the machine-readable series will be expanded to encompass a great proportion of DBS publishable output.

2.17 Another and increasingly important form of output arises from the skill and know-how of DBS professional staff who are called upon frequently by researchers in government, universities, task forces and elsewhere to provide assistance and advice in the utilization and interpretation of statistics.

An Overview of the Subject Matter covered by DBS, Its Sources and Uses
(See Chapter 7)

2.18 It is difficult, in view of its vast range, to provide an adequate picture of the various DBS subject matter programs, their sources and uses,

in brief space. However, an attempt is made to do so in Chapter 7 in which the statistical information produced by DBS is summarized under three headings:

(i) People and their families. DBS statistics cover the major events in the individual life cycle (birth, school enrolment, labour force participation, marriage, health, death) as well as many other variables which are related to the economic and social condition of the individual (family composition, expenditures, incomes, assets, indebtedness, and so on). The statistics are based on information secured from administrative records, household sample surveys and censuses. In particular, the demographic, social and economic information gathered by the census is made available in much finer regional detail than is possible to provide between censuses. A large variety of cross-classified material is also released. At the moment, DBS is in the course of preparation for the 1971 Census. Extensive experimentation and research is being carried out to determine the most efficient and economical way to conduct the census, improving on the past in the light of experience and up-to-date methodology and technology.

(ii) Organizations. Included here are private and public businesses; federal, provincial and municipal government departments and agencies; and various private non-commercial institutions such as hospitals, universities and so on. Most of the organizations falling under this heading are covered in considerable detail by DBS statistics. However, while the aggregate amount of information produced is large, some organizations are covered more completely than others, reflecting factors such as the degree of interest in the data and the extent of record keeping by the organizations. While DBS presents their quantitative and measurable characteristics, users study other aspects as well, making use, of DBS basic data in the process. Statistics in the field of

business and finance are fairly comprehensive, reflecting a well organized system of internal business accounts from which significant data can be drawn. Statistics about the operations of governments are fairly complete at federal and provincial levels but less so at the municipal level. The adequacy of information about the great variety of non-commercial institutions varies--hospitals and their cost structures are covered in detail while the statistics on educational institutions now require considerable expansion.

- (iii) Information on the structure and functioning of the national economy and its major components. The production, distribution and financing of the nation's output of goods and services involve countless transactions. These transactions consist of buying and selling goods and services, hiring labour, investing capital, discharging debts and renting property, paying taxes, receiving pensions, giving gifts. As just indicated, the records of these transactions form the basis for producing numerous statistical series. However, these series must be summarized into a limited number of significant categories in order to provide a manageable and useful picture of the structure and functioning of the economy as a whole and its major parts. The most comprehensive of these statistical summaries are the national income and expenditure accounts, balance of international payments, input-output tables, financial flow accounts and national production and productivity indexes. These statistical summaries are briefly described in the last section of Chapter 7.

Research and Development in DBS
(See Chapter 8)

2.19 It is difficult to draw a precise line between work in DBS which is and that which is not research and development. To analyze, test, correct or revise data to make them reflect more accurately conditions in

the real world are major elements of professional work in DBS. These elements are inextricably interrelated with its research and development. Frequently the skill and alertness of the person in charge of the statistical product, as well as the nature of the product, have a considerable influence on the degree to which research and development activities are an integral part of its production.

2.20 Chapter 8 features activities whose major content and orientation is designed to introduce significant changes in the character or composition of the DBS output or the method of producing it, or the manner and detail in which it is presented and analysed.

2.21 The development and implementation of major changes in the statistical process--whether they take the form of developing new statistical series or significant improvements of existing data, or in the efficiency of producing them--is an intricate and time-consuming matter. This arises from the complexity of the statistical production process or from the complexity of the events being measured, or both. A major aggravating factor in Canada is that research and development to introduce changes of a type discussed in Chapter 8 involve the utilization of human skills and experience which, as pointed out before, are as yet very scarce. DBS has used the assistance of experienced university personnel on specific projects.

2.22 In contracting research projects DBS has a strong preference for the work to be done in DBS or in close collaboration with its officers. Thus it has used sparingly outright "contracting out" arrangements although it is not opposed to them in principle. A major problem of such contractual arrangements is controlling the work and securing the important feedback benefits of the research activity. However, in some situations contracting out is the only way to proceed with much needed research and developmental work. In others, it is the efficient way to proceed, all told.

2.23 Some specific illustrations of research and development in DBS are provided in Chapter 8.

Statistical Production and Automation
(See Chapter 9)

2.24 While DBS has nearly a decade of experience in using computers, it is only in recent years that it has been in a position to use them in a way that would automate the entire operation involved in surveys rather than just certain parts. As is true in so many other organisations, it took considerable experience to appreciate fully the fact that the most effective utilization of computers requires a fundamental restructuring of the processes in which they are used. Computers cannot be superimposed effectively on existing processes, but rather the entire processing must be designed to take into account the fact that the computer will be used. In short, the process must be automated rather than simply computerized.

2.25 Until recently the computer facilities available to DBS imposed serious limitations on both production and research work. The development in the Ottawa area of a number of alternative service bureau facilities has eased the immediate problem and the pending acquisition of a new major computer system within DBS will augment substantially the computer capacity available to DBS.

2.26 Another limitation has arisen from the very limited supply of computer programming and systems analysis resources heretofore available. As in the case of equipment, these difficulties are being mitigated by a build up of the programming resources. However, the DBS establishment contains a high proportion of inexperienced programming staff and the development and implementation of appropriate training programs are an important element in its plans.

2.27 Automation of several major DRS surveys is in process of completion and it is expected that the automation program will gain further impetus through development of general computer systems applicable to the processing of a number of surveys. The most advanced development to date along these lines is to so-called "geographically referenced data storage and retrieval system". This system, which DBS hopes to apply to the 1971 Census, will give rise to substantial improvements in rendering census and other data available quickly on the basis of small geographic areas. The

computer programs of the system will assign geographic latitude and longitude coordinates to every census record in major urban areas. The coordinates will represent the approximate location of each household. Similar but more approximate identifiers will be developed to attach to census records in the rest of the country. These systems, together with some related developments, would make it possible for any user to identify on a map most small geographic areas for which he wants tabulations and these would be provided him rapidly and economically, subject to confidentiality restrictions. The DBS time series data bank, referred to above, is another major development in the automation program. This data bank consists of information stored on disks or tapes plus a set of computer programs which permit the electronic processing and manipulation of data in certain specified ways.

2.28 DBS is also planning for the effective use of optical character recognition equipment. It should soon be possible to fit much of DBS data into computers in the form in which they are initially collected with less clerical intervention than was formerly necessary and with a reduced need for key punching and verification.

Relationships with Users and Suppliers of Data
(See Chapter 10)

2.29 It is essential for the DBS to maintain close and continuous liaison with users of statistics--government departments, business organizations, labour organizations, universities and so on. As already suggested DBS must be equipped with subject matter specialists, as well as experts in methodology, who can effectively communicate with users to help detect and evaluate user requirements and ways and means of satisfying them. DBS has developed, over the years, a comprehensive network of relationships with users, as well as suppliers of information. Formal and informal channels have been established to reach governments, businesses, academic and other users. Formal arrangements take the form of conferences, committees and panels, numbering about 125. At least as important, is the more informal type of personal relationships which evolve between the statistical officials and users in governments, universities, business and labour

organizations and elsewhere in the course of carrying out their daily work. In recent year, DBS has striven to arrange its affairs in a manner which leaves its professional workers some time to develop needed contacts and to make themselves available when their personal advice and consultation is sought.

2.30 From time to time suggestions are made that it would be an advantage to have in Canada a national focal point for the encouragement and co-ordination of research in the social sciences similar to that which exists in the natural sciences. This proposal is of special interest to DBS as an additional channel through which the Bureau could learn of activities in the social sciences and thus serve the research community better.

Relationships with Agencies Abroad
(See Chapter 11)

2.31 Close relations with statistical agencies and groups outside of Canada are of particular importance to a statistical agency such as the DBS. The statistical offices in the various countries and international agencies are a part of what is becoming a world statistical system in which, under the leadership of the United Nations, comparable definitions and standards are established, aimed at facilitating comparability of various statistical series between countries. Close relationship with statistical groups abroad is also necessary for the purpose of sharing know-how in concept and procedures for measurement. It can be said there is a world body of knowledge in statistical matters to which all countries can contribute and from which all can draw help and stimulation. For purposes of international statistical studies DBS supplies a great deal of statistical information to a variety of international agencies.

The Process of Priority Setting in DBS
(See Chapter 12)

2.32 The extensive relationships with users of statistics described above is necessary for establishing objectives, for setting priorities and for evaluating progress made. The process of priority setting in the Dominion Bureau of Statistics is inherently a complex one and formal

procedures involving cost-benefit type of measurement are not yet feasible. A great deal of judgment and intuition is necessarily involved in the setting of priorities, against a background of experience and knowledge of the various factors at play. The process of appraising the existing program and assessing new needs goes on throughout the year and culminates during the annual periods of regular program reviews when extensive examination of the various issues is carried out.

DBS Plans
(See Chapter 13)

2.33 DBS has embarked on programs designed to accelerate its capacity for meeting contemporary demands for information with more speed and flexibility. These plans, which are described in Chapter 13, may be outlined as follows:

- Closing serious statistical gaps such as exist in the fields of services, construction, education, prices, and family expenditures; and improving and extending the statistics on family incomes, balance of payments, financial flows, industrial output and productivity, and in the health, welfare, judicial, demographic and a number of other fields. In addition, special efforts will be made to increase regional and small area statistics.
- Extending the program now under way to improve the timeliness of statistical releases.
- Enlarging substantially the Bureau's capability for taking household surveys.
- Automating much of the Bureau's work using computer technology, and enlarging the necessary planning, programming and mathematical skills required for this.
- Exploiting more fully existing Bureau data by extending both subject matter analysis and projection work based on these data.
- Embarking on projects related to more efficient management: in particular, the establishment of (a) a comprehensive planning system to ensure maximum efficiency and effectiveness in the

utilization of resources; and (b) a management cost and progress reporting system specially tailored for the Bureau.

Developing a suitable training and career development program designed to enhance skills and the attractiveness of DBS as a place in which to work.

PART II

DETAILED DISCUSSION

CHAPTER 3FUNCTIONS, ORGANIZATION, PERSONNEL, BUDGETFunctions

3.1 The Dominion Bureau of Statistics is a government department under the Minister of Industry, Trade and Commerce. It was created 50 years ago by legislation, referred to as the Statistics Act, which sets out its functions. The functions of DBS are described as follows:

"There shall be a Bureau under the Minister, to be called the Dominion Bureau of Statistics, the duties of which are

- (a) to collect, compile, analyse, abstract and publish statistical information relative to the commercial, industrial, financial, social, economic and general activities and condition of the people;
- (b) to collaborate with all other departments of the government in the collection, compilation and publication of statistical records of administration according to any regulations;
- (c) to take the census of Canada as provided in this Act; and
- (d) generally to organize a scheme of co-ordinated social and economic statistics pertaining to the whole of Canada and to each of the provinces thereof."

3.2 The Act then sets out the duties of the Dominion Statistician. * Besides administering the DBS and submitting an annual report, the Dominion Statistician is required:

- "(a) to advise on all matters pertaining to statistical policy and to confer with the several departments of government to that end;
- (b) to organize and maintain a scheme of cooperation in the collection, classification and publication of statistics as between the several departments of government."

These duties envisage a high degree of centralization of statistical activity and authority within the federal government.

3.3 Reflecting the intent of this legislation, the objectives of the Dominion Bureau of Statistics may be outlined in greater detail as follows:

- (a) to provide all levels of government, other organizations and individuals, quantitative information needed for understanding the Canadian economy and Canadian institutions and for the development of economic and social policies and programs, and for the efficient administration of such activities;

- (b) to contribute to the efficiency and productivity of the Canadian economy by providing information necessary for good decision-making.
- (c) to identify areas of need for statistics, to develop new or expanded statistical information designed to facilitate research and analysis in the social sciences, to undertake appropriate research and analysis, and to enhance the usefulness and utilisation of statistics.
- (d) through encouragement of the use of uniform concepts and classifications and by other means, to promote and co-ordinate, in cooperation with other federal departments and provincial government departments, a Canada-wide program of statistical activity designed to render the whole statistical system more coherent, effective and efficient.
- (e) to co-ordinate and promote, at the national level, systems of statistical information in such fields as health, welfare, and education.
- (f) to develop new statistical techniques and procedures for improving the quality, timeliness, efficiency and usefulness of statistics and provide advice to other government departments and the community on the application of statistical methodology;
- (g) to develop data processing, tabulating and retrieval techniques to take advantage of the rapidly advancing computer technology and make these techniques available to other departments and the community;
- (h) to collaborate with the departments and agencies of the federal and provincial governments in the collection, compilation and publication of statistical information derived from administrative records;
- (i) to promote a program of co-operation with federal and provincial governments to keep to a minimum the burden on respondents who supply the basic data required for statistical purposes;
- (j) to take the Census of Canada at regular intervals;
- (k) to provide for the collection, compilation and publication of information as required under the Corporations and Labour Unions Returns Act;
- (l) to promote the international comparability of statistics and to assist the developing countries in the training of staff for statistical operations.

Obligation to Report and Secrecy Provisions

3.4 The brief extracts from the Statistics Act quoted above recite the general duties of DBS. The Act contains, also, two basic features, found in statistical legislation in most other countries. The first of these is a legal obligation to provide information to the statistical agency. This legal power, with penalties, is rarely used in Canada, but its existence is a necessary element in the process of persuasion by which data

are normally secured. The power to demand information is logically complemented by the second major feature of the legislation--a guarantee that information about any person or organization will not be disclosed. The secrecy clause of the Statistics Act requires, in essence, that the information will not, without consent of the respondent, be made available in a form which identifies it with any particular person or organization. The Act has not been revised for many years, and revisions are about to be proposed to bring the legislation up-to-date.

Organization

3.5 The attached organization chart describes in broad terms the headquarters organization of the Dominion Bureau of Statistics. As will be seen, the organization, headed by the Dominion Statistician, consists of four central management groups with Bureau-wide functions, a central information services group, and four subject matter branches, comprised of a number of subject-matter divisions each of which is responsible for a broad range of statistical series in a related set of subject-matter fields.

3.6 The subject-matter professionals in these divisions represent a large variety of specialized know-how in fields as far apart as health, criminology, sociology, demography, commerce, finance, economics, industry and education. The common features which they share are an understanding of the characteristics, interrelations and complexities of their respective fields. They are in continuing contact with those who supply the raw material for statistics and with those who use statistical series in final form.

3.7 The headquarters organization reflects major features of a central statistical office, many of which revolve about the four management groups shown in the upper part of the chart. The advantages of large-scale specialized and centralized data processing in an age of increasing computerization are evident in the existence of a distinct Operations and Systems Development Branch, which provides data processing and related services for the whole organization. Reporting to the Assistant Dominion Statistician for Administration and Finance are staffs that provide a variety of Bureau-wide administrative services including budgeting and

DOMINION BUREAU OF STATISTICS
ORGANIZATION
December 1, 1959

DOMINION STATISTICIAN

Walter R. Duffett

PERSONNEL ADMINISTRATION

Director - G. Labossiere

Program
Coordinator

K.J. Martin

Information Division

Year Book Division

ASSISTANT DOMINION STATISTICIAN
(Finance & Administration)

Responsible for the internal administration of the Bureau and the external relations this involves; development and application of co-ordinated reporting systems for management purposes, costs, financial budgeting and forecasting required by the management and by central agencies; assisting in the development of DBS general policy, particularly resource development and utilization.

Assistant Dominion Statistician - H.E. Allen

Management Information Service

Financial Services

Office Services

Records Co-ordinator

OPERATIONS & SYSTEMS DEVELOPMENT
BRANCH

Responsible for the utilization of resources in developing and maintaining programs for efficient data processing and operational methods throughout the Bureau; synchronizing the utilization of computer and other processing facilities with divisional operations; long term planning of computer and related requirements including data storage and retrieval.

Director General - J.A. Blackiston

Tabulating Service Division

Central Programming Division

Central Registers-Planning & Maintenance

Management Services

ASSISTANT DOMINION STATISTICIAN
(Integration & Development)

Responsible for the integration of the whole range of economic and social statistics; in the light of users' requirements, the overall improvement and development of statistical information covering the wide range of subjects encompassed by the Dominion Bureau of Statistics; Bureau-wide programs of research and analytical studies; the development of sampling and other up-to-date statistical methodology and promoting their application throughout DBS; co-ordination of inter-branch statistical programs; guiding the co-ordination of inter-divisional statistical activities and their integration with programs of other government departments; assisting the Dominion Statistician in the formulation of policy.

Assistant Dominion Statistician - S.A. Goldberg

Regional Statistics Research & Integration

Sampling & Survey Research

Econometric Research

General Classification & Company-Establishment Integration

Special Manpower Studies & Consultation

Central Planning and Programming

Consultant on Demographic Research

ECONOMIC ACCOUNTS BRANCH

Responsible for the assembly and analysis of statistics within an overall national accounting framework; statistics of the Canadian balance of international payments and international trade; indexes of real domestic product by industry, including the Index of Industrial Production; aggregate and detailed industry productivity statistics; the Canadian Statistical Review; the development of a Bureau-wide program of seasonal adjustment; the establishment and maintenance of data banks of economic time series.

Director General - H.B. Carty

Balance of Payments & Financial Flows Division

National Accounts, Production & Productivity Division

FINANCIAL STATISTICS BRANCH

Responsible for planning, developing and implementing programs designed to produce statistics on gross capital formation, construction, corporation profits, and assets and liabilities of corporations; and other statistics such as housing permits, expenditures on research and development by government and business, and revenues and expenditures of government. The Branch is also responsible for the administration of the statistical program called for under the Corporations and Income Tax Act.

Director General - G.A. Maglin

Co-ordinator - Financial Statistics

Corporation & Labour Union Returns Act Admin.

Business Finance Division

Government Division

Central Personnel Record System

ECONOMIC STATISTICS BRANCH

Responsible for statistics of primary and manufacturing industries, including energy fields; motor vehicle, air, rail and water transportation; employment, earnings and hours worked; pension plans; labour income; public utilities; Canada's Foreign Trade; retail, wholesale and service trades; prices and family expenditures; as well as current statistics for emergency supply planning, Unemployment Insurance Commission statistics and input-output studies.

Director General - V.H. Berlinguette

Co-ordinator - Input Output Studies

Labour Division

Transportation & Public Utilities Division

External Trade Division

Manufacturing & Primary Industries Division

Prices Division

Merchandising & Services Division

SOCIO-ECONOMIC STATISTICS BRANCH

Responsible for the decennial and quinquennial censuses of population and agriculture; statistics of elementary, secondary, higher and adult education vocational training and school finances; statistics of agriculture; health and vital statistics; judicial statistics. The Branch is also responsible for the field operations of C.R.S., including the labour force survey; and to provide provincial liaison and consultative services.

Assistant
Dominion Statistician - L.S. Roughetton

Co-ordinator - Consumer Finance Research

Census Division

Special Surveys Division

Education Division

Health & Welfare Division

Agriculture Division

Provincial Liaison & Consultative Services Staff

cost reporting and control. The Director of Personnel Administration is responsible for overall manpower resource functions including recruitment, training, classification and staff relations.

3.8 Reporting to the Senior Assistant Dominion Statistician (Integration and Development) are staffs which provide professional services and carry out research in areas such as sampling, survey design, quality control, response error, standard industry, occupation, geographic and other classifications, econometric applications, and research designed to integrate and co-ordinate further the statistical output. While DBS operations may appear large in total, the individual subject-matter divisions are of a relatively modest size and in a decentralized scheme of things could not afford the skill and specialized resources which they can draw from the central staffs. Several small staffs attached at the centre, and wherever feasible in the branches and divisions, carry out special analytical studies and research in a range of subject-matter areas.

3.9 In addition to the headquarters organization, DBS has eight regional offices which are not shown on this chart. These offices extend from Newfoundland to British Columbia, engage in data collection for a number of surveys and function as focal points for the census of population.

Personnel Policies and Practices

3.10 The inquiries in the Guidelines seem to reflect procedures for the hiring and using of professional personnel which, while characteristic of agencies engaged in research in the natural sciences, differ somewhat from those used in the Dominion Bureau of Statistics.

3.11 The Bureau requires a wide range of skills including those of the administrator, manager, computer programmer and systems analyst, statistician, economist, sociologist, demographer, mathematician and a variety of subject-matter specialists. Many DBS jobs call for officers who combine some of these skills in varying degree. Consequently, DBS can make effective use of persons with university degrees in related disciplines whether they are primarily oriented towards research or other professional activities involved in the statistical process. Thus the Bureau concentrates, in

co-operation with the Public Service Commission and through individual contacts with faculty members at universities, on recruiting graduates who have acquired high standing in university work and who have at least an honours degree, preferably a master's degree. It is the combination of academic work and subsequent experience in the Bureau which determines the direction of an officer's career into research, subject-matter management and development or a combination of the two.

3.12 Staff members with special skills in research are identified primarily through actual performance rather than on the basis of a priori criteria. In the course of his work the varied talents of an individual become evident to his superiors. Efforts are made to channel the professional staff into areas of greatest interest and potential development through appraisal panels and through personal assessment. Judged to be of the highest importance is the contribution that an individual officer makes to the statistical program in which he is involved.

3.13 It is Bureau policy to promote from within, where the work can be carried out well by staff members, before seeking skills outside.

3.14 The pay and classification framework of the Public Service does not, in general, provide for formal distinctions between administrators of research and researchers in terms of formal promotion policies or classification levels and pay scales, except at the most senior levels.

3.15 Several years ago the Bureau introduced an appraisal process designed to focus attention on performance and potential rather than "years of experience" in order to give due weight to contributions and skills of exceptional professional personnel. Thus special promotion treatment has been granted to both researchers and research administrators in recognition of outstanding contributions, as determined by supervisory appraisal panels and reviews and recommendations by senior management.

3.16 Professionals are encouraged to take university courses in subjects relevant to their work and to prepare for advancement to more difficult or responsible positions and, in line with government policy, individuals taking courses are reimbursed 50 per cent of the tuition fees upon successful completion. Within the financial and time constraints, professionals attend seminars, conferences and meetings of particular interest to the Bureau and are generally encouraged to broaden their knowledge and skills.

3.17 Education leave involving extended absence from the Bureau may be approved if the knowledge and skill to be acquired are directly related to the work and are in short supply. For this type of leave a scaled cost-sharing formula is in effect by which the department assumes up to 100 per cent of the costs depending on the degree of relevance and urgency. Educational leave without pay will usually be granted where the objective is of less relevance or urgency to the department.

Personnel Requirements

3.18 The greatly increased need for highly trained professional staff, the severe shortage of such talents and the keen competition for people with similar skills among federal government departments, provincial governments and industry confronts the Bureau with a difficult resource situation. Recognition that more professional talent must be secured by the Bureau has led to an increased involvement of the Bureau's senior professional staff in recruiting activity; and to greater use of semi-professional staff (the administrative and technical categories) to relieve professionals for more urgent research and development assignments.

3.19 The advent of computer technology and its application to the production of statistics has had two important effects on Bureau staff. A powerful tool has been made available to Bureau officers which is enabling them to increase their productivity. At the same time, it has reduced the

relative proportion of clerical support staff. This is reflected in the following table:

Establishment of the Dominion Bureau of Statistics								
Fiscal Year	Executive and Professional		Technical and Administrative		Administrative support and Other		Total	
1956	173	11.3%	74	4.9%	1,275	83.8%	1,522	100%
1960	244	14.0%	139	8.0%	1,369	78.0%	1,744	100%
1964	320	14.7%	305	14.1%	1,542	71.2%	2,167	100%
1968	514	16.9%	603	19.8%	1,924	63.3%	3,041	100%

3.20 If the Bureau succeeds in carrying out its present recruiting plans, 17 per cent of the staff will be in the executive and professional categories, 20 per cent in technical and administrative and about 63 per cent in administrative support and operational categories by the end of the current fiscal year.

3.21 However, to date the Bureau's success in recruiting professionals has fallen short of plans and expectations, as reflected by the establishment data, but considerable progress has, nevertheless, been made. The number of professionals totalled 417 (14.8%) of the total number on strength at September 30, 1968 compared to 188 (11.1%) on September 30, 1960, while the proportion of technical and administrative personnel rose from 9.3% to 20% in the same period. The slower than anticipated growth in professional staff is attributed to overall shortage of qualified applicants and the continuing high rate of separations.

3.22 Although the total number of professionals in DBS is relatively large, the range of skills which the statistical process requires, the scores of subjects for which the Bureau publishes statistics, means that the number assigned to any one area is small. Constant pressure on small staffs has been conducive to inadequate attention being devoted to the development of human capital to cope with the increasingly difficult tasks of management, planning, analysis, research, systems development and automation. The evolving of suitable training and career development programs will be

getting high priority during the next few years. (See Appendix 1 for detail on the characteristics of DBS establishment and personnel)

Budget

3.23 The budget of the Bureau has grown from approximately \$12,000,000 for fiscal year 1962-63 to over \$27,000,000 in 1968-69. This growth reflects new and expanded or improved statistical programs; growth in the number of records requiring processing, reflecting the growth of the economy; growth in development of automated procedures and associated increases in computer programming and mathematical staff with a view to raising output per man; growth in subject matter research and analysis and in more comprehensive integration of statistics; extensive testing and other preparations for the 1971 Census; increase in information services activities; more comprehensive requirements of management, administration, personnel and financial programs; and, of course, price and salary increases. (Appendices 2 and 3 provide detail of DBS expenditures, by fiscal year, from 1962-63 to 1968-69 by branches, divisions and programs.)

CHAPTER 4THE EVOLVING PATTERN OF DEMAND FOR STATISTICAL SERVICES

4.1 During the last 25 years there has been a marked change in public expectations of governments to influence economic and social events, and a growth in the capacity and disposition of business firms to understand and adapt to their environment. These developments have required greatly improved information and this led, in turn, to enlarged expectations of the statistical system.

Government Statistical Needs

4.2 The depression of the 30's and the management of the war economy which followed, created a great need for the understanding and control of economic forces by governments. These needs stimulated the study of basic economic facts and institutions by theoreticians such as Keynes, and provided an opportunity for testing theoretical propositions, with encouraging results. Governments committed themselves to post-war obligations in the fields of employment and social programs to a degree not previously believed practicable. The analytical foundation for these measures was novel in several respects but especially in one - it was quantitatively oriented. The main concepts such as savings, investment, the labour force, employment and unemployment, inflation and deflation, all invited measurement, and measurement was forthcoming in such forms as statistics of the gross national product, statistics of income and savings, and the labour force.

4.3 Many of these ideas came to Canada from abroad. However, the Rowell-Sirois Commission before the war envisaged an unprecedented degree of federal-provincial responsibility for social welfare; and wartime management of the Canadian economy was in many respects an impressive demonstration of government economic management. The post-war federal-provincial conferences on reconstruction and the creation of the Department of Reconstruction confirmed a continuing role for government, supported by federal-provincial agreements, in attempting to ensure a sustained level of national output.

4.4 There ensued a period of relatively gradual development, in which the theoretical and statistical ideas of the war and post-war period were consolidated. In the early 60's an expansion of government policy into new areas took place, involving a range of selective measures which called for more detailed and varied information. Among federal agencies which were created during this period were the Economic Council, ARDA, the Area Development Agency, the Atlantic Development Board, the National Energy Board, the Department of Industry, the Department of Manpower and Immigration, etc. These bodies were research and action-oriented and urgently needed quantitative information. The Bureau of Statistics met many of their initial needs, and subsequently the support of these and other agencies assisted the Bureau to obtain more resources with which to extend its program.

Provincial and Municipal Statistical Needs

4.5 A striking feature of recent years has been the acceleration in economic and social policy development at provincial and municipal levels. The problems of rapidly growing urban areas and underdeveloped areas within provinces have created problems which required attention and have created major data needs. The statistical requirements of the provinces, especially for small area information, have played an increasingly important role in the development of DBS programs.

Royal Commissions

4.6 The postwar period has seen growing use of Royal Commissions and Task Forces as a research instrument, particularly at the federal level. As temporary agencies, they have naturally depended heavily on existing statistical resources and frequently in their recommendations have identified important areas of statistical development which needed expansion. The DBS has worked closely with these Commissions, supplying them with special tabulations and analysis, advising on the uses and limitations of data and, in some cases, loaning experienced staff.

Universities and Research Bodies

4.7 The quantitative orientation of modern research in the social sciences has brought the universities and the statistical system closer together, a tendency which will undoubtedly grow further. The virtual common interest between the two in certain research fields is indicated by the authorship of recent Census Monographs, in which some volumes are authored by university staff, others by DBS staff, and another jointly. The flow of personnel between DBS and the universities has been of great advantage to both, and DBS has been in a position, in recent years, to make greater use of contract employment of university professors for long and short periods. This is a pattern which has existed extensively in the U.S. and the U.K. and has proven useful in Canada.

4.8 Universities themselves in their teaching programs are giving increasing attention to statistics, computer sciences and other aspects of the quantitative investigation. Some have set up institutions for research in the social sciences, devoted largely to quantitative studies.

4.9 Independent research bodies have also appeared, often quantitatively oriented and usually with DBS participation. Two examples are the Canadian Council on Urban and Regional Research, and the National Cancer Institute; and abroad, such organizations as the International Association for Research in Income and Wealth.

Business Research

4.10 Research by business institutions, whether they be trade associations or individual firms, continues to grow and, at the same time, they make increased use of statistically-oriented business consultants. Market research is frequently based on DBS material; but may include intensive analysis of the firm's own data, or special surveys using sampling or other techniques undertaken by specialized firms. A combination of competitive pressures and availability of data have continued to stimulate market and industry studies and the prospect is for a continuation of these trends.

International Agencies

4.11 International agencies such as ILO, IMF, FAO, WHO and OECD develop their policies to a great extent on the basis of statistical information. They have played an important role in developing statistical standards and in encouraging statistical development in Canada and other countries. The need for international comparisons on a broad scale has been reflected in demands by the U.N. Statistical Office for data from national statistical offices.

CHAPTER 5SOME DEVELOPMENTS IN THE ORGANIZATION AND METHODOLOGY
OF STATISTICS TO MEET GROWING DEMANDS

5.1 Concurrent with the massive demands for additional information, certain improvements have taken place in the methodology of securing, analyzing and organizing statistics which have helped to satisfy the demands while, at the same time, they have stimulated them further.

Importance of Integration

5.2 Because statistical series are usually used with other statistical series, seldom in isolation, they must be constructed as an integral part of a mutually consistent overall design. The importance of integration in statistics has been recognized in Canada for many years. Indeed the Departmental Commission of 1912, which recommended in its report the establishment of a central statistical organization, emphasized strongly that statistics "should constitute a single, harmonious system, with all divisions in due correlation". More recently the importance of integration was highlighted by the Royal Commission on Government Organization. This recognition is now world-wide and is reflected in the following statement of the Fifteenth (1968) Report of the United Nations Statistical Commission to the Economic and Social Council: "It is becoming increasingly evident to members of the Commission in their national statistical work that statistical series are now typically used in conjunction with one another, in such fields as government administration and in studies of economic and social phenomena... For various reasons, national statisticians have felt obliged to attempt by every means at their disposal to achieve the greatest degree of comparability between different statistical series and programmes". In Canada, two major instruments for integrating DBS statistics, the national accounts and standard classifications, have contributed substantially in the post-war years to the development of a comprehensive statistical system to meet growing needs.

The National Income and Expenditure Accounts and Their Extensions

5.3 In the realm of economic statistics unquestionably the most notable development in Canada, and indeed in other countries, has been the construction of a regular set of national income and expenditure accounts. These accounts have had a profound influence on the demand and utilization of economic data and hence on statistical programs in general. As will be indicated later, the accounts have provided a relatively simple quantitative framework within which various policy objectives could be reasoned out in a disciplined manner. They have been conducive to developing a greater awareness and interest in economic events and a more orderly and quantitative approach to the study of economic problems.

5.4 Closely related to the contribution of the accounts to economic analysis is their contribution to the anatomy and content of the system of economic statistics. Since the concepts, definitions and major category and sector distinctions of the accounts stem from the requirements of economic theory and practical economic analysis, the implementation of the accounting system has led to adoption of more consistent and meaningful definitions and distinctions in the primary data. They have provided an integrated quantitative framework for appraising existing information and for evaluating gaps, inconsistencies and other imperfections in the data. More recently other related statistical accounting systems--in particular input-output, financial flows, production and productivity--have been constructed, with similar beneficial effects on the utilization, analysis and the integration of statistics.

Standard Classification Systems

5.5 Aside from the influence of the various national accounting systems, an indispensable foundation for achieving coherence of statistical information from various sources are standard classification systems. Such systems, which have undergone substantial evolution in recent years, are designed to be used for classifying information from a variety of sources such as censuses of production, employment surveys, censuses of population,

surveys of capital expenditures, financial statistics, external trade statistics, and so on. Through the application of the same classifications to a wide range of statistics, obtained in different surveys, the data are secured and compiled on a standard basis, thus rendering the results more comparable and useful. DBS has developed in the post-war years a Standard Industrial Classification for classifying establishments through the whole range of economic activity from agriculture to manufacturing to services; a Standard Commodity Classification to serve as a means for co-ordinating statistical categories in external trade, domestic production, materials used, commodity freight transportation, and so on; a Standard Geographical Classification for the purpose of classifying systematically statistics relating to geographical areas within Canada. A Canadian Classification and Dictionary of Occupations is in process of preparation, in collaboration with the Department of Manpower and Immigration, to provide for Canada a multi-purpose instrument for use in manpower research, administration and statistical data collection.

Developments in Survey Methodology and Mathematical Applications

5.6 A major contribution to the accumulation of statistical information has taken place in the area of survey research. In particular, the development and application of mathematical theories of sampling and of other survey methodology have opened up new frontiers of statistical data collection and processing. Originally imported from the United States, the techniques of probability sample surveys of households have been further developed and adapted to Canadian needs. Their first major manifestation was the establishment, after World War II, of the monthly Labour Force survey.

5.7 Sample surveys have made possible more frequent and accurate reporting of demographic and economic information. Thus, in addition to employment and unemployment, the labour force survey organization has been used to collect information on other characteristics of the population: age, sex, occupation, industry, hours worked, income, expenditure, education, immigrant status, smoking habits and so on. As a matter of fact, the labour force survey organization has been overloaded and a much needed ex-

tension of DBS household survey capability is included in DBS plans for future programs, as indicated later.

5.8 Equally as important as sampling methods has been the development of theories which explain and render manageable the other sources of errors in surveys (non-sampling errors). The statistical production process is a complex system consisting of several interlocking phases and operations, each of which affects the accuracy of the final results, on the one hand, and the cost of the entire operation, on the other hand. Thus, it is not enough to design one part of the survey operation (such as sampling). What is essential is that the system should be efficient as a whole. The mathematical theories of sampling enabled statisticians to cope effectively with sampling errors; the theories developed during the last 10 years are enabling statisticians to deal more effectively with errors of reporting, processing errors, editing errors and so on, as well as with the total impact of them all. Thus, the contribution of the mathematical statistician has broadened from that of designing samples to participation in the design of the various elements of the statistical operation.

The Role of Computer Technology

5.9 The development of modern disciplines of survey design and statistical production have coincided in recent years with the rapid development and harnessing of computer technology. The massive contemporary demands for statistics are increasing the need for automation. In the area of economic statistics the Bureau has been fairly successful in a number of instances in combining the modern methods of survey design with automation. As indicated later, the Bureau is also developing, as part of its overall automation programme, several computer-oriented general data storage and retrieval systems. In particular, a "Geographically Referenced Data Storage and Retrieval System" and a time series data bank, which are being developed, are significant developments in this direction. Furthermore, a machine-readable "Central List of Companies and Establishments", covering all businesses in Canada, is being developed; it will speed up the automation of business surveys and, at the same time, serve as a powerful tool of inte-

gration. Through comprehensive automation of its operations the Bureau is seeking to extend the usefulness of the data which it collects, i.e. to develop data storage and retrieval systems permitting fast retrieval of data in the form in which it is needed by users.

Reducing the Gap Between Demand and Supply of Statistics

5.10 The demand for statistics has always exceeded its supply and despite the growing capacity of statistical organizations to produce information, the gap between demand and supply has widened. This appears to be a world-wide phenomenon. Demand for statistics has tended to grow at a rapid and relentless rate, especially in recent years. In Canada the need for new types of information in many areas, for more timely information and for higher quality information is recognized in the DBS and has been strongly emphasized by the Economic Council of Canada, the Bank of Canada, parliamentary committees, Royal Commissions, provincial government bodies and many others. It should be noted, however, that the rate at which the supply of information can be accelerated is determined by certain restrictive practical and technical considerations. Past and present limitations in the way of satisfying user demands have included shortages of trained professional and technical staff, the burden of response on suppliers of data, the difficulty of evaluating some demands in precise terms and the inherent difficulty of measuring certain phenomena. In addition, the lead time involved in developing new, better or more timely statistics is much greater than is generally supposed.

5.11 Within the foreseeable future it is anticipated that the shortage of experienced economists and statisticians will gradually ease and that the fuller utilization of administrative records for statistical purposes will reduce the need for increasing the burden on respondents as more statistics are developed. Certain limitations imposed by statistical legislation could be avoided by enhancing DBS capability for analysing raw data for users. The greatest promise for reducing the gap between demand and supply of statistics lies in the automation of DBS work which, as indicated above, should result in a more flexible and quicker supply of statistics.

CHAPTER 6THE OUTPUT OF THE DOMINION BUREAU OF STATISTICSOutput in the Form of Statistical Data

6.1 Most of the output of DBS takes the form of publications and press releases, although the issuing of data in machine-readable form is increasing. The general publication program, while very large, is concentrated on the information which is most commonly used, as it is neither necessary nor possible to include compilations which would serve every purpose or need. Thus a large amount of unpublished information is provided on request, usually in the form of special tabulations.

Regular and Occasional DBS Publications

6.2 DBS publications include over 500 regular statistical reports which appear annually, monthly or quarterly, plus over 200 occasional publications.* In addition, there are the 400 publications of the results of the 1961 and 1966 censuses. Most of the regular publications are basically statistical, with two notable exceptions, the Canada Year Book, a 1250-page statistical volume with important contributed articles on national institutions and activities, and the handbook Canada, a 300-page illustrated volume used widely abroad as well as in Canada. A recent addition to DBS publications has been the "Statistical Observer" designed to inform users and other interested groups about statistical activities in DBS and elsewhere in Canada. Many of the DBS regular reports appear monthly, quarterly, as well as annually, and well over 1 million copies of reports, including the Canada Year Book and Handbook, but excluding the daily and weekly bulletins, are distributed in a year.

Machine-Readable Output

6.3 In addition to printed publications, machine-readable data is issued in the form of computer tapes and punch cards. For example, summary

* For a complete list of DBS publications see DBS Catalogue supplied to Committee members with this brief. See also Appendix 4.

tapes of census data are made available in response to requests from individual users. In the near future, the Bureau expects to have available for users, in machine-readable and other forms, the services of a time-series data bank which will consist initially of some 7,000 non-confidential statistical series, each extending over a period of years. This data bank, described later, was developed on foundations created by the Economic Council and will be extended substantially to include additional series.

Special Tabulations

6.4 A considerable volume of information, including special tabulations, is prepared in response to inquiries from users. In a recent period of three months over 1,700 replies were mailed, providing information in response to inquiries. (This does not include many inquiries dealt with by telephone which were much more numerous.) Almost half of these replies were in response to requests by the business community. In addition, considerable numbers of people visit the Bureau to obtain information directly.

Custom-made Tabulations

6.5 Although ready-made tabulations in printed form, on tape or on other media will continue to be the major form of publication in the foreseeable future, the importance of custom-made tabulations and analyses is likely to increase. In an effort to meet this anticipated demand, DBS is striving to develop a capability for providing such specially designed tabulations to users quickly and at moderate cost.

Monographs, Special Studies, Papers and Manuals

6.6 The professional staff of DBS have prepared a large number of special studies, papers and monographs dealing with subject matter and methodological problems and related matter. A selection of these are listed in Appendix 5. In addition, the various standard classifications (industry, commodity, geographic, etc.) developed by DBS for statistical purposes

have been published in the form of manuals and are widely used throughout Canada for non-statistical as well as statistical purposes.

Secondary Distribution

6.7 The release of data represents the primary distribution of information by DBS, but there is a very large secondary distribution through reprinting of DBS information in newspapers, trade journals and by trade associations, as well as broadcasting by radio and television. Then, of course, a great deal of DBS material is built into research studies and reference publications appearing in books, learned journals, reports of Royal Commissions and publications of a wide variety of public and private organizations.

Output in the Form of Professional Assistance to Others

6.8 Another, and very important, form of output arises from the skill and know-how of DBS professional staff who are called upon frequently by researchers in governments, universities and elsewhere to provide assistance and advice in various conceptual and methodological problems, on ways of utilizing and interpreting data and methods of designing surveys and research projects. Such services are limited by available DBS resources and demand is likely to grow.

CHAPTER 7AN OVERVIEW OF THE SUBJECT MATTER COVERED BY DBS,
ITS SOURCES AND USES

7.1 As the central statistical agency of the Government of Canada, the Bureau provides a comprehensive and diverse spectrum of information covering almost all aspects of social and economic conditions in Canada and ranging from national and provincial aggregates to detailed data by small geographic regions. Despite this diversity, the statistical information DBS produces can be summarized under three headings:

- (i) People and their families;
- (ii) Organizations - private and public businesses, federal, provincial and municipal government departments and agencies; and various private non-commercial institutions, such as hospitals, universities, and so on;
- (iii) Information on the structure and functioning of the national economy and its major components.

In what follows an overview is provided of DBS statistics, their sources and uses, under these headings.

People And Their FamiliesSources of Statistics

7.2 DBS information covers the major events in the individual life cycle (birth, school enrolment, labour force entry, marriage, death), as well as many other variables which are related to the economic and social well-being of the individual. This information is secured from administrative records, sample surveys and censuses. The administrative records are obtained mostly from provincial and local government agencies which are charged with the recording of certain events, such as births, marriages, deaths, crimes and illnesses, among others. A number of household surveys are conducted in order to obtain current information in specific subject fields. Prominent among these are the monthly labour force survey, and surveys of family incomes and expenditures.

7.3 Every five or ten years DBS conducts a national census--of individuals, their families, households and houses. A great deal of demographic, social and economic information is gathered and is tabulated for groupings of individuals and families. These data are made available in much finer regional detail than it is possible to provide between censuses. A large variety of cross-classified material is also made available. At the moment DBS is in the course of preparation for the 1971 Census. Through a network of contacts with users, DBS tries to ascertain the most important topics to be covered. Extensive experimentation and research is carried out to determine the most efficient and economical way of conducting the census, improving on the past in the light of experience and up-to-date methodology and technology.

7.4 Administrative records, surveys and the census are three major vehicles through which DBS compiles and publishes information for groupings of individuals and families in the following subject fields.

Birth Statistics

7.5 DBS receives microfilms of birth registrations from the provinces and these are used as a basis for compiling data on births: the number of births by age of parents, residence of mother, multiple births, stillbirths and illegitimate births, sex of the newborn. The census also collects data on the number of children born to married women. Such information is useful for public health programs and in projecting the structure and growth pattern of the Canadian population.

Education Statistics

7.6 As children reach school age and subsequently, they are covered by DBS statistics on the number of individuals attending public and private schools, colleges and universities. The statistics on schools under public control are obtained from or through the Provincial Departments of Education. The data on colleges and universities are secured directly from the institutions concerned. Surveys are also conducted on professional qualifications and salaries of teachers. Direct studies have been made of

students enrolled at universities--their cost of schooling, family background, and so on. In addition, the census obtains data on school enrolment and educational attainment. Statistics on school enrolment and on the age distribution of the population are of great value in preparing forecasts of the demand for school accommodation at different educational levels, and for teacher training. Statistics on educational attainment are essential to an assessment of the quality and utilization of Canada's human resources.

Labour Force Statistics

7.7 On leaving school a high proportion of the population enters the labour force, and it is of great importance to know where and how fully they are employed. The monthly labour force survey conducted by DBS provides timely information on employment, unemployment, hours of work, industry and occupation. Detailed data on the occupation and industrial distributions of the labour force are also provided by the census. Labour force statistics are a sensitive indicator of the state of the economy and a timely guide to those determining government and business policies.

Marriage Statistics and Statistics on Families and their Characteristics

7.8 The labour force survey and census data are also classified by marital status but the main DBS statistics on marriages and the characteristics of marriage partners are based on microfilms copies of registration of marriages which DBS receives from the provinces. With marriage a new family is, of course, formed. DBS covers a variety of characteristics of families, or equivalent units, through the various surveys it carries out, and through the census: data on the number of families and their characteristics; incomes of families; household facilities and equipment, and so on.

Statistics on Incomes of Families and Individuals

7.9 Statistics on the distribution of income by size are another essential series for the evaluation of the economic well-being of the population. These statistics are collected by specially designed sample surveys,

as well as the census. They provide information on the sources and size of income and are classified by economic and demographic variables such as age, occupation, family size and so forth. These statistics have many research and policy uses--they were used by the Senate Committee on Aging in evaluating the adequacy of the incomes of the older population, by the Economic Council in delineating the nature and characteristics of the poor segments of the population, and by government departments in studying the effects of government social welfare measures on the income distribution.

Statistics on Assets and Indebtedness of Families

7.10 The Bureau also carries out sample surveys of assets and indebtedness of families at various income levels. These data have been used by royal commissions and others in estimating the possible effects of inflation on the financial position of families at different income levels, in appraising the possible impact of tax changes on different income groups, and so on.

Crime Statistics

7.11 DBS receives its source data on criminal offences directly from court officials and police departments. The data provide separate information on indictable and other offences committed, on juvenile delinquency and the characteristics of the offenders. Such data are useful in studying the volume and range of police protection the various communities need.

Statistics on Illness

7.12 DBS collects regularly statistics on communicable diseases, patients in hospitals, hospital facilities, mental illness, and various aspects of health care. These data are an important element in measuring the adequacy of health services provided to Canadians. Changes in patterns of morbidity have important socio-economic effects on the population and social institutions. The shift of the incidence of illnesses from the communicable diseases to chronic diseases have identified a need for changes in the composition of health services.

Statistics on Death

7.13 DBS statistics on deaths are based on microfilmed copies of provincially registered death certificates. Mortality data contain information on the number and geographic distribution of deaths in Canada by the age and sex of the deceased and causes of deaths according to internationally agreed upon classifications. Mortality statistics are useful in calculations of expectation of life at all ages. The rates of neo-natal and infant mortality along with that of maternal mortality provide indicators of the progress achieved in the fields of medical science and public health.

Business, Government and Other Organizations

7.14 Most of the organizations included under this heading are covered in detail by DBS statistics. While DBS presents their quantitative and measureable characteristics, many other agencies, government and private, study other aspects, usually making use of DBS basic data in the process. While the aggregate amount of statistical information is large, some organizations are covered more completely than others, reflecting factors such as the degree of interest in the data and the extent of record keeping by the organizations. Statistics in the field of business and finance are fairly complete, a reflection of a well-organized system of internal business accounts from which significant data can be drawn. Statistics about the operations of governments are reasonably complete at federal and provincial levels, but less so at the municipal level. The adequacy of information about the great variety of non-commercial organizations varies. Hospitals and their cost structures are covered in detail, while educational institutions, although well-served by the accepted standards of a few years ago, now require considerable extension. For reasons of space, the remainder of this section deals only with statistics obtained from business organizations.

7.15 A substantial portion of DBS resources are devoted to collecting and publishing statistics pertaining to business organizations. These include business firms and individuals engaged in such varied activities as manufacturing, agriculture, services, transportation, merchandising and

finance. The major sources of business statistics are first described, followed by an outline of some of the uses.

Sources of Business Statistics

7.16 The two principal sources used by DBS for its business statistics are mail surveys and censuses, and administrative records.

Mail Surveys and Censuses

7.17 Questionnaires, covering the information needed, are mailed out to the various business organizations. The questionnaires are designed to obtain information from the records of the organizations in question. These mail surveys or censuses are the basis of a large variety of statistics covering most of the primary and secondary industries and a large proportion of the commercial and service industries. A brief summary of some of the surveys or censuses in these areas follows:

7.18 The annual censuses of industry, covering operations of Canada's manufacturing, mining, forestry and public utility industries provide a wide array of industry, commodity and geographic detail. They are supplemented by monthly and quarterly surveys of the more important products and activities including the extensive monthly coverage, by industry, of the value of manufacturing shipments, inventories and orders. Similarly, comprehensive annual surveys, supplemented by monthly inquiries, are used for the transportation and communications industries. Agriculture is covered by quinquennial censuses supplemented by monthly and annual sample surveys. In the area of merchandising and service trades, information is obtained through a wide variety of collection techniques ranging from a quinquennial census, covering in detail all retail and wholesale businesses and a large segment of service industries, to annual surveys of retail and wholesale trades and significant service industries, to weekly surveys of department store activity. As well, many monthly series are published in the retail, wholesale and services field.

7.19 A quarterly sample survey of assets, liabilities, net worth, revenues, expenditures and profits covers approximately 5,000 financial and non-financial corporations. Surveys of capital and repair expenditures provide annual forecasts and realizations for all sectors of the economy and by province. A new quarterly survey is being introduced to provide more current national indicators of investment spending.

7.20 Regular monthly surveys produce a wide variety of price statistics. These include measures of consumer price movements for detailed categories of expenditures. Industrial prices measure price movements of outputs and inputs of individual industries and groups of industries. In the area of labour statistics, in addition to the Job Vacancy Survey, there is a broad and varied program of establishment inquiries providing data for the monthly employment indexes and the monthly series on average weekly wages and salaries, average hourly earnings, average weekly hours and total employees and their earnings.

Administrative Records

7.21 Administrative records include data originally collected for other purposes. Some important examples of such data sources follow: The monthly statistics of Canada's imports and exports are compiled from documents collected by the Department of National Revenue and cover a wide range of product detail. Annual statistics from the financial statements filed by corporations under the Income Tax Act, which are available to the Bureau under the Corporations and Labour Unions Returns Act, are the source of a very comprehensive set of company financial and related statistics. Administrative records of the Unemployment Insurance Commission and the Canada Manpower Centres of the Department of Manpower and Immigration are the sources of data which reflect the operations of these agencies and which are also used for statistical purposes.

Uses of Business Statistics

7.22 Uses of business statistics can be divided into two main types:

- (a) Macro-economic uses in which the emphasis is put on economic aggregates,

measuring the general performance of the economy and its major parts; and (b) micro-economic uses in which the emphasis is put on the operation of an individual company or an individual industry. Each of these can be further divided into studies primarily concerned with flow information of the details of goods and services produced, and materials and services consumed; and structural studies focussing on financing, ownership, size, geographical distribution and type of products. Several examples follow:

The Ownership and Financing of Business

7.23 Over the past 20 years a good deal of attention has been paid to the extent of foreign ownership of Canadian business, and DBS publishes considerable information on this subject. Data have been provided for studies of industrial concentration and industrial development possibilities. A question of considerable interest is that of how business is financed and during the next year new information of this type will become available on a regular basis.

7.24 Individual companies, through analysis of various relationships (such as the ratios of profits to sales, cost of sales to total sales, current assets to current liabilities) are able to compare their performance and profitability with the total of those in the same industrial category. Financial institutions find such comparisons very useful in deciding the risks involved in granting credit.

Market and Cost Studies

7.25 These are carried out by individual firms and business consultants. Business concerns make wide use of the Bureau's large array of commodity statistics. A manufacturer may compare his output with that of the combined total of his competitors' output to determine his relative position; he may compare his sales or shipments to a consuming industry with the total consumption of that industry to find out whether he is gaining or losing a share of his business to his competitors; he may want to study the impact of imports upon his industry and upon his own plans for expansion. Such comparisons of the statistics about his own market operations with

those of his competitors or his customers may direct attention to certain shortcomings, which, when discovered and obviated, could put his company in a better competitive position.

Price and Labour Statistics

7.26 A growing, though as yet inadequate, network of price statistics, at different levels of the productive process provide early indications of supply and demand pressures, and brings these to the attention of government departments and agencies concerned with monetary and fiscal policy. For establishing policies regarding wages and working conditions and for collective bargaining, hourly and weekly earnings data are required regularly by the business community. A special feature of many wage contracts for which wage and price data are frequently requested are escalation clauses in long-term contracts. Similarly, special combinations of commodity price indexes are produced for business firms involved in long-term supply contracts for purposes of escalating the contract price in accordance with the effect of changing prices on costs of materials of the producer.

Regional Statistics

7.27 Regional and urban studies require not only information about persons, their incomes, education, etc., but also a great deal of detail about industrial and commercial development, job vacancies and so on. Many new agencies at the federal and provincial levels concerned with regional problems have appeared in recent years and they require an increasing amount of such regional detail for policy and administrative purposes.

7.28 Statistics derived from business organizations are, of course, also used in constructing the various economic indicators and aggregates described in the following section.

The Structure and Functioning of the National Economy
and Its Major Components

7.29 The production, distribution and financing of the nation's output of goods and services involve countless transactions. These transactions consist of buying and selling goods and services; hiring labour, investing capital, discharging debts, and renting property; paying taxes, receiving pensions, giving gifts. As already indicated, the records of these transactions form the basis for producing numerous statistical series. However, these series must be summarized into a limited number of significant categories in order to provide a manageable and useful picture of the structure and functioning of the economy as a whole and its major parts. The most comprehensive of these statistical summaries are briefly described here.

The National Income and Expenditure Accounts

7.30 As indicated in chapter 5, one of the great achievements in the sphere of economic statistic in the post-war years has been the development of methods for constructing such summary statistical statements. These statements contain totals and subtotals which are now well-known: the gross national product; the national income; personal income; personal saving; gross national expenditure; government expenditure on goods and services; personal expenditure on consumer goods and services; domestic investment; and so on.

7.31 The various totals and subtotals are presented in accounting format which are accordingly referred to as the "national income and expenditure accounts". Separate income and expenditure accounts are constructed for four major sectors of the economy, as well as for the economy as a whole: all persons; all businesses; all governments; and all transactions with non-residents (the balance of payments accounts).

7.32 The various components of the accounts are further subdivided into as many industry, commodity and regional aggregations as the available statistics permit. The expenditure components are adjusted for changes in prices. Both the income and expenditure components are published quarterly as well as annually.

7.33 A major use of the income and expenditure accounts is in the field of economic public policy as they provide basic background information on the state of the economy as well as an integrated structural system within which specific proposals can be examined and tested for consistency. The Accounts also provide the business community and the general public with a set of tools for analysing the course of economic events within a quantitative framework. The presentation of the statistics in the Accounts is such as to demonstrate the interdependence of economic events, thus greatly facilitating economic analysis, consistent projections and the building of economic models: they demonstrate that wages are a cost of production as well as income which permits purchases; that taxes are at once expenditure (to the taxpayer) and revenue (to governments); and so on.

The Balance of International Payments

7.34 Although conceptually an integral part of the national income and expenditure accounts, special attention is accorded the balance of international payments and related figures. An open economy such as Canada is exposed to powerful economic forces from abroad and these must be measured as accurately as possible. Among the component series one of the most important is the international investment position, with information on the inflow and outflow of capital and the degree of foreign ownership of Canadian industry. Canada's international financial relationships are extremely complex and the role of new and changing financial institutions here and abroad must be understood. Another important element in these figures is the tourist trade, which offers particular problems of measurement.

Input-Output Tables

7.35 An important extension of the income and expenditure accounts are the so-called input-output tables. These tables are designed to show the sales of specific industries to all other industries and the consumption by specified industries of goods and services produced in other industries. The tables also show how much consumers and governments have purchased from

the various specified industries and how much was exported by these industries. Clearly the construction of such tables is a vast undertaking, involving a massive array of detailed information on commodities and services produced, purchased, imported and exported by all industries and sectors of the economy. By providing a detailed integrated picture on the structure of inter-industry relations such tables provide basic information for studying the ramifications of economic pressures and events which have their first impact on a particular point of the economy or from abroad. A new set of input-output tables and related studies is expected to be published in the spring of 1969.

Financial Flow Accounts

7.36 Another important extension of the income and expenditure accounts utilizes financial statistics and takes the form of a set of financial flow accounts. These accounts provide information on changes in assets and liabilities of the various sectors of the economy and are designed to show, among other things, who is borrowing and who is lending and the financial instruments through which this borrowing and lending takes place. They thus provide a quantitative framework for studying, in conjunction with other information, policies and developments in regard to the money supply, the liquid position of the economy and measures designed to ensure that the financial system facilitates stability and growth in the production of goods and services. It is expected that a set of financial flow accounts will be published during the coming year.

National Production and Productivity Indexes

7.37 An altogether different summary arrangement of statistics takes the form of indexes of production of various industries. The best known of these indexes is the monthly index of industrial production which is one of the major sensitive indicators of current economic activity. The procedures used in constructing the index of industrial production have been extended to cover all industries of the national economy and these are published quarterly. The changes in this overall index, which correspond

to the changes of an index of gross national expenditure adjusted for price change, provide an up-to-date picture of the changing industrial composition of national output. Together with suitable statistics on labour employed in production, the output figures are used in the construction of productivity indexes. Vitally important inferences regarding the functioning of the Canadian economy are frequently made on the basis of these indexes and an allowance for strengthening their accuracy has been included in the DBS plans for future programs.

CHAPTER 8RESEARCH AND DEVELOPMENT IN DBSIntroduction

8.1 This chapter, is devoted to a description of research and development work carried out within the Bureau. In point of fact, it is difficult to draw a precise line between work in DBS which is and that which is not research and development. In the last analysis, research and development is undertaken with a view to implementing a change for the better, usually involving considerable study, experimentation and testing. At the same time, the statistics produced by DBS are designed to help people adjust to a changing world and adjustments are required in the statistics produced: e.g., revisions in standard classification systems to reflect changes in industrial developments; periodic revisions in the consumer price index to take account of the changing composition of the purchases made by Canadian families; periodic revisions in various aggregates, such as the national accounts and production indexes, to assimilate new or better information. To analyse, test, correct, or revise data to make them reflect more accurately conditions in the real world are major elements in professional work in the DBS. These elements are inextricably interrelated with its research and development. Frequently the skill and alertness of the persons in charge of the statistical product, as well as the nature of the product, may have a considerable influence on the degree to which research and development activities are an integral part of its production.

8.2 There are, nevertheless, activities whose major content and orientation are designed to introduce changes in the character or composition of the DBS output, or in the method of producing it, or in the manner and detail in which it is presented and analysed. These are the ones which will be featured here.

The Objectives of Research and Development in DBS

8.3 The objectives of research and development in DBS are:

- (i) to develop new statistical information to serve the needs of users;
- (ii) to integrate and render more consistent and coherent statistics from various sources so that they can be used jointly;
- (iii) to analyse available statistics for the purpose of shedding light on various aspects of Canadian society and the economy;
- (iv) to develop new and more efficient methods for collecting, processing, presenting, analysing and disseminating information, and, in general, to reduce cost of production per unit of statistical output and to improve the timeliness, reliability and usefulness of statistics.

Research and Development and the Complex Character of Statistical Measurement

8.4 The development and implementation of major changes in the statistical process--whether they take the form of developing new statistical series or significant improvements of existing data, or in the efficiency of producing them--are frequently an intricate and time-consuming matter. This arises from the complexity of the statistical production process or from the complexity of the events being measured, or both.

8.5 There are numerous interrelated links in the chain of events which result in the regular release of statistics. Many phenomena are difficult to measure because little is known about them initially or because the concepts underlying them are difficult to pin down in precise enough terms to provide meaningful statistics. This is particularly true when regular records with regard to the phenomenon being measured are not kept by the respondent. Where records are kept problems arise because they are often not in a form needed for statistical purposes. Considerable field work and experimentation are usually involved. As more is discovered about the character of the events being measured, the various phases of the survey are adjusted. Again, a great deal of testing and experimentation is

involved when the survey is automated. The various activities must be undertaken with due regard to the final overall outcome rather than the impact of one or several steps. Through a series of successive approximations an efficient overall production system is finally created, yielding statistical results which can be endorsed as adequate in view of the purposes of the information and the funds available. Appendix 6 contains an illustration of the steps involved in a major and complex new survey, the job vacancy survey which is being developed.

8.6 Some phenomena, aside from being intricate, cannot be measured adequately (or at all) because they have to be based on a great deal of information much of which is not yet available. Initiation, or major improvement, of such series must therefore await the strengthening of the underlying data. For what is worse than no information is misleading information.

8.7 A case in point is productivity statistics. The regular release by DBS of official national productivity indexes was begun in 1965. It was preceded by a good deal of analysis, many years of experimentation and basic research aimed at reducing or eliminating discrepancies in the primary information and extending the coverage of certain data, especially of labour statistics. The DBS productivity statistics now compare favourably with those of any other country. Yet the road ahead to meet contemporary requirements is more formidable than that already covered. The estimates have to be improved in accuracy and timeliness and more detail by major industrial groups is needed. The productivity ratios can, of course, be no better than the output and input components on which they are based. Substantial improvements in the productivity ratios necessarily involve corresponding improvement and broadening in the statistical base of the components.

The Shortages of Experienced Professional Staff

8.8 A major aggravating factor in Canada is that research and development to introduce changes of a type discussed here involve the utilization

of human skills and experience which, as indicated in Chapter 3, are as yet very scarce. The programs of research and development to effect changes for the better must be paced accordingly.

Assistance from University Staff

8.9 DBS has been trying to build up its complement of professional and technical skills and, as indicated later, this objective is prominent in its future plans. At the same time, attempts are made to secure the assistance of experienced university personnel on specific projects. To illustrate, the Director of the Econometric Laboratory of Laval University spent some time this summer at DBS to prepare a report on what the future program of input-output research and analysis at DBS should be and how it should be organized in relation to other programs. An econometrician from the University of Western Ontario has spent two summers at DBS to develop a quarterly econometric model for estimating missing information from available data and plans are under way for entering into a continuing arrangement with him to complete this work and to undertake related research. A sociologist from the University of Western Ontario provided assistance in connection with certain census concepts and tabulation formats. A demographer from the University of Western Ontario and an economist from McMaster University have collaborated with DBS staff on the analysis of labour force participation of married women.

Use of Commercial Consultants

8.10 Where appropriate, commercial consultants are utilized to provide urgent assistance. To date, such services have been used in preparing for the acquisition and installation of the new large-scale computer to be established in DBS in the summer of 1969, and in the establishment of a network planning system for the 1971 Census. DBS also intends to experiment with the use of commercial programming organizations in connection with some of the major projects now being developed, and if these experiments are successful DBS will probably provide for regular use of such facilities on a small scale to handle peak loads. This will both speed the development

of key projects, and benefit DBS staff by exposing them to techniques and methods employed in other organizations.

Intramural and Extramural Research and Development

8.11 In contracting research projects DBS has a strong preference for the work to be done in DBS or in close collaboration with its officers. It has used sparingly outright "contracting-out" arrangements, although it is not opposed to this in principle. A major problem of such contracting arrangements is controlling the work and securing the important feedback benefits of the research activity. However, in some situations contracting out is the only way to proceed with much needed research and development work. In others it is the efficient way to proceed, all told. Successful DBS contracting-out arrangements include a contract with a consultant firm to advise in connection with the early conceptual research on a computerized geographic coding system; with a professor from the University of Toronto to develop a computer system for the identification of address components, the correction of spelling errors, and the development of a general retrieval program to be used on large "random-access" stored files. Negotiations are under way with a potential contractor for the development of software to enable DBS to plot city maps as part of the computer output of the geographic coding system.

Some Specific Illustrations of Research and Development in DBS

8.12 The Dominion Bureau of Statistics has built up research teams in many areas: manpower, productivity, econometrics, classification, prices, consumer income and expenditure, finance and balance of payments, input-output, demography, regional analysis, sampling and survey methodology, among others. These research teams are typically small.

8.13 Reference has been made, in Chapter 6 to various research and analytical papers and studies published by DBS professional staff. Some specific illustrations of research and development activity in DBS are included here. Additional reference to such work is made later in the chapter on DBS plans.

Work in Sampling Leading to Improved Design of the Labour Force and Other Household Sample Surveys

8.14 The largest sample survey of the Bureau is the Labour Force Survey. It was originally designed shortly after the war and although over the years several improvements were introduced, the procedures underlying the survey became considerably outdated due to the rapid socio-economic changes which took place in the country.

8.15 In 1962 a decision was made to redesign the survey. New techniques were developed to achieve an optimal design. A mathematical model was developed to reflect the cost of the survey under alternative designs and another model was created to reflect the sampling error of the survey under alternative designs. Using these two models the optimal design was derived, optimum in the sense that the resulting survey would have the smallest possible sampling error for a given cost.

8.16 The implementation of this optimal design also involved the development of several new survey methods. These included the development of new methods to render the sample more representative so as to reflect the balance between urban and rural populations as well as the different income, occupation and industry patterns. Since this survey is also used as a vehicle for other inquiries, a major objective of the new design was to create a survey, which could be used in a highly flexible fashion. In particular, major emphasis was put on the development of methods to enable DBS to increase or decrease the sample size for different inquiries, as required, as well as to enable DBS to implement design changes and improvements in a flexible fashion when and where required.

8.17 The reliability of the survey estimates was improved (without cost increases and in fact at some cost reduction) by a margin which within the old design could only have been achieved through increasing the sample (and hence the cost) by a factor of 2 to 3.

Work on Non-sampling Errors Leading to Improved Method of Census-taking

8.18 When an interviewer enumerates a person or a household then, typically, the following steps are involved: the question is asked by the interviewer; information is provided; the interviewer receives the information and records it. For certain factual and non-controversial questions (for example, age, sex, relationship of members of the household to the head) this is a fairly accurate procedure. For most substantive inquiries, this procedure is error-prone to a considerable degree (particularly with an inexperienced crew of interviewers). Such errors are called response errors and are substantially affected by the interviewers. Estimates from sample surveys are, therefore, subject to both sampling errors and response errors. Estimates from full count censuses are subject to response errors only.

8.19 At the time of the 1961 Census a new theory was tested, and an intricate operation was devised, making it possible to estimate the response error to which the census estimates were subject. Moreover, the method enabled DBS to estimate how much of the response error can be attributed to interviewers.

8.20 This work has had a profound influence on DBS thinking concerning census methods and, in the final analysis, led to the proposal of a new method of census-taking for the 1971 Census, that of self-enumeration. This method involves a substantial reduction of the role of interviewers eliminating most of the error from this source.

Manpower Research

8.21 A series of analytical and methodological research reports, which are published under the title of Special Labour Force Studies, was initiated two years ago. These studies (nine of which have been published to date) cover a broad range of topics of interest to social scientists, policy makers and others concerned with the economic, social and demographic aspects of manpower resources in Canada. Thus the series has dealt with subjects such as the educational attainment of the Canadian labour force;

annual work patterns; occupational distribution; geographic mobility; post-war immigration; female labour force participation; inter-generational socio-economic mobility. The research is based on household survey data derived, in the main, from special questionnaires attached to the Monthly Labour Force Survey.

Census Monograph Studies

8.22 In order to assist government and private officials, as well as the Canadian public in general, in the interpretation of the massive volume of statistics produced in the 1961 Census of Canada and to provide a feedback for the planning of future censuses several monographs analysing intensively the 1961 Census data were undertaken. Under the authorship of DBS and university professors, monographs were prepared on the general topics of fertility, income, labour force, merchandising, migration, post-war immigrants and urban growth. Four of these monographs have been published, and three more are being processed for publication. In developing these monographs the authors synthesized, analyzed and interpreted large masses of statistics, using up-to-date methods to produce books which are proving to be valuable additions to the research literature in their respective fields.

Population (and related) Projections

8.23 Population projections are essential inputs to efforts at systematic planning for the future in both the government and private sectors. They are used in deriving other kinds of projections, such as labour force, families, school enrolment and housing demand, as well as in forming judgments about the future magnitudes of a variety of social and economic variables. Thus it is not surprising that public and private agencies demand projections. DBS has been trying to meet this demand, which is growing continually. In the past the Bureau has from time to time undertaken the preparation of projections for internal use by a variety of government departments. More recently, projections of population, manpower, and school enrolment carried out by DBS experts have served as the basis

for much of the tabular material and discussion in the First and Fourth Annual Reviews of the Economic Council of Canada. In the light of the growing demand for projections in Canada, DBS plans to begin periodic publication of population projections by sex and age for Canada as a whole in 1969 and to strengthen its capacity for making projections on related variables for other government departments. These activities in the projection field require systematic development of (a) population studies which analyze recent trends as a basis for assumptions as to future trends; (b) mathematical models for forecasting shifts in the components of population change and for integrating the results of these shifts; and (c) estimation procedures needed to obtain measures of the values of parameters in the mathematical models.

Balance of Payments and Non-resident Investment

8.24 The quality of the Bureau's statistical data and analysis in the field of balance of payments and non-resident investment is widely recognized, reflecting as it does important pioneering work, as well as continuing research effort. An active role is played in initiating special studies to provide additional information and perspective on foreign investment. Examples include studies of the manufacturing operations of Canadian and foreign-controlled enterprises to elucidate variations in industrial and regional distributions, size, capital intensity, etc. Another is the study of the relative importance of Canadian and foreign investment in various Canadian industries, and the financing of the foreign investment component. In the balance of payments field, research has led to greatly improved measures of highly volatile short-term capital flows. Work is currently proceeding in a number of areas such as the development of measures of accrued earnings. In addition, assistance is provided regularly to individuals engaged in research in the area and to other organizations by providing technical advice and, from time to time, by undertaking special studies at their request. Present research capacity is being enhanced by a number of factors including improvements in methodology and data processing techniques.

Financial Statistics

8.25 Financial statistics have been a part of the statistical product of the Bureau since its inception, but the area has come to the fore on a much broader scale since the re-emergence of monetary policy as a major instrument of government policy following World War II. For the study on Financing Economic Activity in Canada (carried out for the Royal Commission on Canada's Economic Prospects), a special research team including a senior economist from DBS produced a study of financial flows in Canada. The results of this study confirmed the value of such statistics as a major analytical and research tool.

8.26 A small research team within DBS was then assigned the responsibility of developing and introducing a system of quarterly financial flows accounts. The research approach to this work has played an important role in ensuring the orderly development of a broad statistical frame within which a wide range of compatible financial statistics on the business, government, personal and rest of the world sectors of the economy are being developed.

Company-establishment Statistical Integration

8.27 The prime objective of this major project is to coordinate the financial and production statistics to allow a flexible response for information within a more consistent and detailed framework than now exists. One phase of this research effort will be directed at the primary or collection level in collaboration with a number of large companies. A careful study of their records is involved to determine what amendment in reporting procedures would be conducive to producing more consistent financial and production statistics. The implications of the growing use of electronic data processing equipment by large business firms for the collection and production of statistics in the future will also be examined.

8.28 Another phase of this investigation involves a detailed study of corporate income tax returns of small and medium-sized corporations which are available to the Bureau under the Corporations and Labour Unions Returns

Act. Because of conceptual differences, data from the tax returns are found to be at odds with the data collected by conventional means in the Bureau and considerable research work is required in this area before a full reconciliation and integration is accomplished.

CHAPTER 9STATISTICAL PRODUCTION AND AUTOMATIONHistorical Background

9.1 Throughout the world the short history of computer utilization has been characterized by a lack of understanding of its impact. At one end of the scale, many users expected miracles that computers were not capable of performing (such as transforming inaccurate or irrelevant input into significant, relevant and precise output) while at the other extreme, many users expected to utilize computers simply as a substitute for a large clerical staff. It took several years to understand (and to translate this understanding into concrete applications) that computers have both extremely powerful capabilities and important limitations and that the productive utilization of computers requires a fundamental restructuring of the processes in which they are used. Computers cannot be superimposed effectively on existing processes, but rather the entire processing must be designed to take into account the fact that the computer will be used. In short, the process must be automated rather than simply computerized. Moreover, the rapid development of computer technology requires a continuous readjustment on the part of its users.

Past Limitations to Automation

9.2 The DBS has nearly a decade of experience in using computers for the processing of surveys. However, it is only in recent years that it has been in a position to use computers in a way that automates the entire survey operation, including file management and data handling. Two limitations (both on their way to being resolved) to the more rapid automation of Bureau surveys might be mentioned.

9.3 Until recently the computer facilities available to DBS imposed serious restrictions on both production and research work. The development in the Ottawa area of a number of alternative service bureau facilities has eased the immediate problem, especially for research work, and the pending

acquisition of a new major computer system within DBS will augment substantially the computer capacity available to DBS. The selection of this new computer system was preceded by a detailed study of the nature and size of the probable DBS workload over a number of years and the development of a series of selection tests.

9.4 The second limitation has arisen from the very limited supply of computer programming and system analysis personnel heretofore available. As in the case of equipment, these difficulties are being mitigated by a build-up of the computer programming resources available within DBS. Obsolete equipment has hampered the recruitment and retention of programmers, resulting in an undue proportion of inexperienced programming staff in the DBS establishment at the present time. Despite these limitations, considerable developmental work has been accomplished and the experience gained by DBS is of great assistance in formulating realistic programs for future automation.

A Major Lesson from Past Experience

9.5 Reference has already been made to the fact that, in general, a survey is a complex operation consisting of several phases: the creation of lists, their maintenance and updating, the selection of samples, the mailing out of questionnaires, check-in of completed questionnaires and follow-up of non-respondents, the editing and correction of raw data (through internal consistency checks or comparisons with past data), the weighting or expansion of sample data to total population levels, the preparation of standard tabulations and analyses and finally the storage of data for special user-requested tabulations and retrievals.

9.6 Several years of experience has taught DBS that the application of computers to only some of the tasks is inefficient. The entire survey has to be structured for automation, i.e. the survey has to be conceived, designed or redesigned with its eventual automated processing in mind. It is only then that the survey will be efficient as a whole. True automation of a survey requires a substantial initial investment of resources. Interdisciplinary cooperation is required involving at least three disciplines:

the subject matter specialist, the survey methods expert and the computer systems analyst.

Accomplishments in Automation in DBS

9.7 The greatest part of DBS production already makes use of computers but automation in the sense defined above has been applied so far to only several major surveys which have been, or are at the last stages of becoming, automated: Survey of Employment and Payroll (large establishments), Sample Survey of Employment (small establishments), Current Shipments, Inventories and Orders Survey, Job Vacancy Survey. These surveys have been selected for automation on the basis of one or more of the following considerations: an immediate payoff in terms of cost, manpower resources, timeliness, reliability, flexibility to provide special service. Another important consideration was the impetus that the automation of these surveys might give to the general automation program. For example, the Bureau has a central list of establishments which covers, by and large, only the major establishments and those of multi-establishment companies. The automation of the Sample Survey of Employment created, as a by-product, a machine-readable list of many establishments not covered by the central list at present. Without this extended machine-readable list the Job Vacancy Survey could not have been developed and automated in the short time that it took to accomplish it. In addition to the automation of individual surveys, it is expected that the automation program of the Bureau will gain further impetus through the development of general systems applicable to the processing of several surveys. The most advanced development along these lines, the geographically referenced data storage and retrieval system and the DBS Time Series Databank, are now briefly described:

Geographically Referenced Data Storage and Retrieval System

9.8 This system, which DBS hopes to apply to the processing of the 1971 Census, is designed to effect substantial improvements in rendering census (and other) data available quickly on the basis of small geographic areas. Its computer programs will assign geographic latitude and longitude

coordinates to every census record in major urban areas. The coordinates will represent the approximate location of each household. Similar, but less precise, identifiers will be developed to attach to census records in the rest of the country. This system, together with some related developments, would make it possible for any user to identify on a map most small geographic areas for which he wants tabulations and these would be provided him rapidly and economically (subject to confidentiality restrictions). This system is described in more detail in Appendix 7.

The DBS Time Series Databank

9.9 The DBS Time Series Databank is the name given to a new vehicle for making non-confidential time series available to the public in machine-readable form. This Databank consists of discs or tapes plus a set of computer programs named CANSIM (short for Canadian Socio-Economic Information Management System) which permit the electronic processing and manipulation of data in certain specified ways.

9.10 These computer programs enable DBS to place data into the Databank, bring them up to date, retrieve them and submit them to mathematical manipulation. These procedures can be carried out electronically for all or any portion of the Databank. In the spring of 1969 the Bureau hopes to make some 7,000 time series available to the public in machine-readable form. As time and resources permit, the machine-readable series will be expanded to encompass a great proportion of DBS publishable output. The Bureau will sell tapes or cards containing all or part of this information as well as a set of programs which will permit customers to manipulate the data mathematically. For some time to come, customers may have to spend some of their own programming resources to render the programs, particularly the manipulative programs, compatible with their own machines. It is, however, planned to expand the programs made available to customers in such a way that the Databank will assume more of a general utility function and can be drawn upon without too much difficulty by all customers regardless of their own hardware configurations. This development will be phased in such a manner that the degree of sophistication of the programs

approximates the demands of the customers. The Bureau will also be ready to perform special manipulative operations if users should prefer to buy the information in this way. It is anticipated that the Time Series Databank will be a self-sustaining operation financially.

9.11 The great advantage of a time series data bank is that by making information available in machine-readable form, it saves customers the necessity of each, separately, converting such data into machine-readable form, i.e. punching cards and then converting them to tape, disc, etc. For the economy as a whole this is efficient since the operation is carried out only once; in addition, the error-generating aspect of data transcription is minimized. The assistance rendered by the Economic Council of Canada in the development of the Databank is gratefully acknowledged. The Databank originated with the Council but at the beginning was directed towards use by a few economic researchers only. It had certain limitations because data could be entered or retrieved from the bank only in sequential order, which was costly and time-consuming; moreover, it could accommodate a very limited number of series. The development of the databank into a more general system based upon direct (instead of sequential) data access was carried out in close collaboration with the Council. It is believed that the DBS Time Series Databank will be the first directly accessible time series databank in the world designed for general data users.

Optical Character Recognition

9.12 Another important development is the planning for the effective use of optical character recognition equipment (document readers) which would make it possible to feed much of DBS data into computers in the form in which it is initially received, with less clerical intervention than was formerly necessary and with a reduced need for key punching and verification. It is expected that these developments will significantly speed the production of statistics and should also help to reduce survey costs per unit of output.

The Dominion Bureau of Statistics of the Future

9. 13 The progressive automation of the statistical process will continue to involve changes in the balance of human resources employed in the Bureau. At one time, it was possible to liken DBS to a factory in which a small handful of statisticians (senior management), and a somewhat larger number of technical officers (foremen), supervised a large clerical-operational staff. This picture is no longer true and it is anticipated that the Dominion Bureau of Statistics of the mid-1970's will probably have the major proportion of its human resources engaged in professional statistical and analytical work, computer programming, planning, administration, and related activities. Such trends are evident (and further advanced) in some other statistical organizations especially the United States Bureau of the Census and the Central Bureau of Statistics of Norway. It should be recognized that this internal structural change will require a continued high recruiting by DBS of graduates of universities and technical institutes, and reduced opportunities for the employment of staff with lower levels of education.

The Probable Major Obstacle to Rapid Automation

9.14 It bears emphasizing that DBS attaches great weight in its future planning efforts to acquiring, training and retaining an adequate complement of experienced computer programming, mathematical, research and subject matter personnel. Commercial organizations have spent many millions of dollars in research and development which is incorporated in the computer equipment that is purchased or rented. The efficient exploitation of this expensive equipment requires an appropriate complement of human skill and know-how; the total computer installation must be conceived as a "man-machine" interdependent complex. Despite its efforts to build up its computer programme and systems and related capability as quickly as possible, DBS fears that the severe shortages of personnel with the required skills and background in these areas will continue to constitute the most serious obstacle to rapid automation.

CHAPTER 10RELATIONSHIP WITH USERS AND SUPPLIERS OF DATA

10.1 It is essential for a statistical department to maintain close and continuous liaison with users--government departments, business organizations, labour organizations, universities, and so on. Furthermore, the statistical department must be equipped with subject matter specialists, as well as experts in methodology, who can effectively communicate with users to help to detect and evaluate the user's requirements and ways and means of satisfying them.

10.2 At the same time, the statistical department must be able to understand the problems and circumstances of respondents (the individual, the firm, the government department who fills out its questionnaires), the information provided by the statistical department to the public being, in the last analysis, limited to the information it secures from the public. What the statistical department does is to secure, systematize, aggregate, cross-classify, analyze and publish this information.

DBS and Suppliers of Data

10.3 DBS has developed over the years effective relationships with respondents through continuous personal visits, conferences, meetings and written communications to consider concepts, coverage, reporting problems and so on. Consultation with business associations and, where appropriate, labour organizations, takes place prior to initiation of major surveys in an effort to conform so far as possible with business accounts and records, and to convey something of the importance of the survey activity. Furthermore, in its dealing with users, DBS tries to represent the point of view of the respondent by emphasizing that there are definite limits to the amount and type of information respondents can supply and the burden they can tolerate. Cooperative arrangements exist for shared surveys with the provinces in a number of areas in order to reduce the burden of response. The remainder of this chapter deals mainly with relationships with users.

A Description of Relationships with Users

10.4 Over the years DBS has developed various arrangements and procedures for detecting and evaluating statistical needs and for establishing objectives and priorities in the light of these needs and for reviewing progress. Formal and informal channels have been established to reach government, business, academic and other users.

10.5 Formal arrangements take the form of conferences, committees, and panels, numbering about 125. At the federal level, interdepartmental committees, usually sponsored by DBS, exist in almost every subject-matter area. Committees with more diversified membership have been set up to promote integration and development of statistics across a wide range of subject matter (such as economic statistics in general) needed by departments and agencies concerned with fiscal and monetary policies, industrial and trade development, short-term and long-term projections. Interdepartmental committees are almost invariably formed during developmental stages of new statistical programs and they frequently continue to function--though they are called together less often after programs are under way--to consider priorities, concepts and new developments.

Relationships with the Provinces

10.6 The ten provinces of Canada engage in statistical activity and several have more or less centralized statistical offices. Committees comprising DBS and provincial officials exist in a large variety of fields, for example, education, mining, agriculture, crime and public finance. Federal-provincial meetings in these and other fields take place at regular intervals. A Federal-Provincial Conference on Economic Statistics, with representation of provincial government users and producers of statistics, meets approximately once every two years. It has set up a variety of working committees that meet more frequently on a range of topics, including labour, interprovincial trade, investment expenditures, population census and prices.

Small Area Statistics

10.7 At both federal and provincial levels interest in statistical information on small areas, municipalities and portions of municipalities has increased enormously in recent years, calling for new arrangements to detect and evaluate demands. A regional statistics staff has been created to strengthen channels of communication with the provinces, to keep DBS management informed of provincial and local statistical developments, to help increase awareness on the part of provincial, regional and urban planning agencies of the services DBS has to offer, and to coordinate and, where necessary, carry out major programs to increase the availability of sub-provincial statistics. The growth of research groups in universities and among town planners concerned with urban problems has been very striking in recent years and DBS has cooperated closely with these bodies. Steps are being taken to equip DBS regional statistical offices with some professional personnel to strengthen regional liaison, become familiar with local needs and help interpret them to headquarters.

Business and Other Organizations

10.8 Joint formal arrangements have been set up with selected non-government users, for example, in the fields of energy and transportation, to consider various problems related to the reporting and utilization of statistics. In addition, DBS officials participate regularly in conferences and meetings sponsored by private business associations and universities and other educational bodies.

10.9 Arrangements such as just listed are indispensable for maintaining two-way communication with users, though they serve other purposes as well. Not only is a great deal picked up which throws light on the existing programs, current deficiencies and future requirements, but the very process of preparation for these conferences and meetings forces statistical officials to take stock and to become more attuned to needed changes. However, perhaps of even greater beneficial and durable impact is the more informal type of personal relationships which evolve between DBS

officials and those of user organizations in governments, universities, business groups and elsewhere in the course of carrying out their daily work. In recent years DBS has striven to arrange its affairs in a manner which leaves its professional workers some time to develop needed contacts and to make themselves available when their personal advice and consultation is sought.

DBS Information Division

10.10 A Statistics Use Development staff has recently been added to the DBS Information Division for the purpose of extending the utilization of statistics by large and small enterprises and research groups which have not been using them, most frequently because they have been unaware of the possible applications of DBS statistics to their affairs. The objective is to enable the benefits to be derived from DBS services to be available to as many potential users as possible. Recently a trained economist has been assigned to each of the regional offices in Toronto and Montreal for this purpose. They work through study groups and seminars, trade associations, business meetings and conventions as well as by individual contacts with university and business personnel and firms to indicate to them the benefits to be derived from the use of DBS information.

10.11 A booklet, How to Profit from Facts, was produced in 1965 and nearly 37,000 copies have since been issued in response to specific requests. The booklet contains case outlines of typical uses of statistics in business, and is intended to encourage use of statistics by non-users. A sample survey was done of the business people who received this publication to estimate its effect. It showed that 17% of the group had not previously made any use of statistics, and were now users, and that a further 31% who had been only occasional users were now frequent users.

A Coordinating Body in the Social Sciences

10.12 From time to time, suggestions are made that it would be of advantage to have in Canada a national focal point for the encouragement and

coordination of research in the social sciences, similar to that which exists in the natural sciences. The proposal is of special interest to DBS, as an additional channel through which the Bureau could learn of activities in the social sciences and thus serve the research community better. As has been mentioned above, the "lead time" in establishing new statistical series is long, and a body of this kind could be of help in anticipating the pattern of long-run research and the corresponding data needs. An example of a useful program which it might pursue would be to coordinate the growing variety of data banks now being planned in the social sciences. At some point such a body might become associated, for purposes of coordination, with corresponding bodies in the natural sciences, although this might not be desirable in its formative stage.

CHAPTER 11RELATIONSHIPS WITH AGENCIES ABROADInternational Comparability

11.1 Close relations with statistical agencies and groups outside of Canada are of particular importance to the Bureau of Statistics for two general reasons. The first is that statistical offices in the various countries are part of what is becoming a world statistical system, in which, under the leadership of the United Nations, comparable definitions and standards are established aimed at facilitating comparability of statistical measures between countries. While a good deal still needs to be done to achieve this objective fully, especially in the less developed countries, a high degree of uniformity does exist among the principal countries of the world. This is of great practical importance because comparisons of administrative programs and of research studies would be very difficult if they were measured by or based on widely different concepts and measurements. Such comparisons are facilitated by a statistically controlled survey such as the labour force survey, but are more difficult where administrative sources are used, e.g. trade statistics, and where statisticians do not have control over the principal stages of recording and measurement of phenomena. Even here, however, much statistical progress has been made through the development of compatible classification systems.

Sharing of International Know-How

11.2 A second reason for maintaining close relationships with statistical groups abroad is the international sharing of know-how in concepts and procedures for measurement. It can be said that there is one large world body of knowledge in statistical matters to which all countries can contribute, and from which all can draw help and stimulation. There is typically only one major statistical office in each country and international liaison is useful in providing the necessary comparisons, stimulation and even a degree of competition in achieving a quality product. Even the most advanced countries derive advantages from this process, and close statistical

collaboration exists between officials of countries of different ideology and stages of economic development. Some of the principal international agencies with which DBS has close relationships are as follows:

United Nations Statistical Commission

11.3 This body, one of the major U.N. commissions, is charged with the promotion, development and co-ordination of statistics through the U.N. Statistical Office, in all U.N. specialized agencies (FAO, ILO, WHO, etc.) and throughout the world. It has been, and continues to be, a great success. The first chairman in 1947 was the then Dominion Statistician, and Canada has been an active and influential member almost without interruption. The International Monetary Fund has performed a similar function with respect to financial and balance of payments statistics and here, also, DBS personnel have been active.

IASI and Conference of European Statisticians

11.4 As a member of the Inter-American Statistical Institute and as an affiliate of the Conference of European Statisticians, both of which are regional bodies linked to the United Nations, Canada has played a significant role. As a relatively sophisticated country, statistically, our role in IASI has been largely one of contributing experience and know-how. In recently developed relations with the influential and highly organized Conference of European Statisticians, there has been a two-way relationship with a significant contribution and great advantages. In the latter organization a considerable number of specialized committees are active at any time and Canada is often a participant.

U.N. Agencies

11.5 Direct contact is maintained with the statistical operations of a variety of United Nations statistical agencies such as the World Health Organization, International Labour Office and the Food and Agriculture Organization. This takes the form of DBS participation in committees of these agencies in developing classifications, standards and survey techniques.

The OECD

11.6 As a member of the Organization for Economic Cooperation and Development, Canada participates in numerous industrial and manpower committees. Most of these have important statistical subcommittees on which DBS plays an active part.

The Conference of Commonwealth Statisticians

11.7 This body meets about every five years for two weeks of intensive study, and maintains liaison between conferences. A common language, private meetings and a general uniformity of governmental traditions all facilitate easy communication. The developing countries now outnumber the old dominions and are playing a more prominent part in the program.

International Learned Societies

11.8 Two prominent bodies in this field are the International Statistical Institute and the International Association for Research in Income and Wealth. Both are active in research in statistical methodology and the latter engages particularly in general subject matter research in its field. DBS staff members play an important part in the organization and programs of these bodies.

Other International Contacts

11.9 There is, literally, continuous informal contact with statistical offices abroad especially in the U.S.A., with an active exchange of information, and a modest degree of technical assistance towards the developing countries.

CHAPTER 12THE PROCESS OF PRIORITY SETTING IN DBS

12.1 The problem of setting priorities in DBS has been a difficult one because of the variety of its statistical products, serving many different purposes, which are difficult to measure and often impossible to compare. Most of the available resources of the Bureau are, of course, committed to maintaining or improving the regular flow of statistics, which have been designed to satisfy the continuing requirements that have been accorded high priority in the past, as well as new requirements that can be satisfied from the same or somewhat improved streams of resource inputs. Furthermore, it is believed that the existing pattern of statistical output reflects a fairly realistic appraisal of priorities and that there are few and trivial cases where new high priority demands can be met by withdrawing resources from ongoing projects. Therefore, new demands normally involve the acquisition of additional resources apart from those which can be found from economies. How then are such demands, stemming from a wide variety of sources and covering a multitude of subject-matter fields, evaluated and compared, and how is this process finally reflected in a system of priorities?

12.2 Ideally, the statistical program should be established by comparing costs and expected benefits of each element in the total program, the existing as well as new components, and then ranking the elements in the order of net benefit. This principle is easy enough to expound but there are intractable problems involved in its implementation. As far as costs are concerned DBS has not, as yet, an adequate records system for cost estimation although it has been moving decisively in this direction in line with recent changes in government budgetary procedures. One element of cost that is difficult to measure is the burden on respondents, but it is, nevertheless, a vital element of the total cost picture that must be weighed carefully.

12.3 As far as the comparison of benefits is concerned, the situation becomes increasingly difficult as we move from individual projects of homo-

geneous sections to combined and diverse programs of divisions, to total programs of branches, and finally, to the whole range of the statistical spectrum. To take a somewhat extreme example, how can the benefits from more data on crime or health be compared with those from more statistics on transportation or the balance of payments? The problem of setting priorities in the Bureau is akin, in principle, to Treasury Board's problem of setting priorities in the allocation of resources between government departments.

12.4 Thus it is extremely difficult to measure and weigh benefits. Ideally, two steps are involved in assessing benefits: (1) to determine which statistical series play a part in which decisions, and (2) to assess the extent to which these decisions are improved by the availability of statistical information. In practice, the latter is particularly difficult to determine. Moreover, since most DBS series are published and often reach ultimate users by passing through several hands, all ultimate uses are not known. Clearly, a thorough knowledge of the problems of users of data and the purposes which the data are to serve is essential to assess benefits even approximately. In many cases this information is conveyed to DBS by users and further clarification is achieved through detailed study by DBS and users in defining the purposes and concepts of the data. The appraisal of relative benefits in the case of intangible or non-comparable projects is based on judgment applied against a background of experience and knowledge of the various factors at play. The process is not necessarily rendered easier by the fact that, in almost all cases brought to DBS attention, benefits appear to exceed costs by a comfortable margin. The difficulty is, of course, that there are not enough resources to do all the good things, and the problem is one of ranking, in order to make the best choices out of many good choices. DBS customers expect responsible, continuous and reliable service, especially since statistical data are usually built into the decision-making process of the enterprise or department. Thus termination of existing series cannot take place in an arbitrary or unilateral manner.

12.5 The process of appraising the existing program and assessing new needs goes on throughout the year, and culminates during the annual periods of regular program reviews when extensive examination and searching evaluation of the various issues are carried out. In the light of Bureau-wide guidelines, examination and evaluation takes place at the divisional level, the branch level, and finally the central level by an executive committee chaired by the Dominion Statistician before submitting the program of the Bureau to Treasury Board.

CHAPTER 13DBS PLANS

13.1 DBS is embarking on programs designed to accelerate its capacity for meeting the contemporary demands for information with more speed and flexibility. Aside from the acquisition of additional resources, these programs involve a shift towards greater reliance on electronic processing equipment, systematic planning in the utilization of resources to ensure maximum efficiency and effectiveness, the augmentation of DBS survey-taking capability, the collection of new and more detailed data, the more complete research and analysis of information collected, and a reduction in the time lag in the publication of information. These programs are described briefly, beginning with a review of major statistical programs being planned for the next four or five years.

High Priority Statistical Programs

13.2 The statistical coverage in the area of prices is widely regarded as inadequate. Yet price statistics, used in conjunction with related data, are central in assessing inflationary pressures, international competitiveness and income policies. Accordingly a substantial extension of the coverage of price statistics is underway. Together with information that will be secured from national surveys of family expenditures and incomes, which are being planned, the extended program of price statistics will also make possible realistic analysis of regional income and living cost differentials and more effective appraisal of the real income position of lower income groups. Information of this sort is badly needed in connection with policy formulation in costly welfare, income maintenance and area development programs.

13.3 A dominant feature of the Canadian economy since the end of the war has been the growing importance of the service industries. Since 1946 more than 80% of Canada's employment growth has occurred in this sector of the economy. It is planned during the next five years to enlarge and improve substantially the coverage of statistics in these areas and it is

expected that this information will facilitate insights into the implications of the changing structure of these industries. Similar strengthening is required in transportation and public utilities statistics.

13.4 The construction industry is a large and highly volatile sector of the economy whose frequent fluctuation is a major source of instability with far-reaching repercussions. Only general and incomplete information is available on this important industry. A program is being developed to improve substantially the coverage and quality of the statistics on the construction industry.

13.5 Improvements are also planned in the statistics on balance of payments, financial flows, national accounts, industrial output, productivity, capital stock, and expenditures on machinery and equipment.

13.6 A major effort is being planned to substantially extend and improve education statistics. This program, which is being developed following recommendations by an independent authority, will be carried out in cooperation with the provinces and national educational organizations. Closely related to improved education statistics is the need to develop reliable data on the occupational and related characteristics of the labour force on a current basis. A program for the development of such information is being considered. The success of the government's selective manpower policies, designed to improve the allocation of labour and upgrade the manpower resources of the country, depends in considerable measure on an extension and improvement of such data as well as the new job vacancy statistics being developed at DBS.

13.7 In view of the large and growing government expenditures on programs in the health, welfare and judicial fields, it is considered that the statistical base in these fields should be strengthened and the Bureau's five-year program has made allowance for this.

13.8 Special attention is being given to the planning of the 1971 Census of population, housing and agriculture. Insistent demands from federal and provincial agencies and other major users are reflected in a considerable extension in the number of questions which are likely to be

asked on the population census. At the same time, recent advances in quantitative techniques in the fields of urban planning, transportation studies and so on and the increased emphasis on local and regional programs for urban renewal and related activities have given rise to demands for quicker, more detailed and cross-classified information on a small area basis. To hold down costs, improve the quality of the data and evolve rapid techniques for releasing the information, research and development is proceeding in the use of sampling as an integral part of the census, new methods for collecting the data, and automated procedures for retrieving the information. In connection with the census of agriculture, a special post-census sample survey is being planned to secure more detailed data on farm operating expenses and incomes than can be collected in the census.

13.9 At both federal and provincial levels interest in small area statistics has increased enormously. The censuses are designed to satisfy as much of these demands as possible for the census year but, in response to demands by the provinces, two other arrangements have been established. One is a provincial liaison and consultation staff to strengthen communication with provincial agencies, and the other is a regional statistics research and integration staff to develop intercensal small area estimates on population, income, employment and so on and to coordinate developments of regional information throughout the Bureau. It is planned to strengthen both these activities. Cooperation with the provinces for the purpose of evolving coordinated approaches to statistics work and to reduce burdens on respondents is being strengthened.

Timeliness

13.10 The DBS has embarked on a comprehensive program designed to effect short-run and long-run gains in timeliness of its statistical series. Substantial gains were made last year in a selected number of key series and efforts are being extended to make improvements on a broad range of series in the next few years. To accomplish this, steps are being taken to eliminate bottlenecks, introduce time-saving collection devices and estimation procedures, develop mathematical models for advance estimates, secure

information earlier from all or a sample of respondents and, in the course of time, automate procedures as far as possible.

Enlarged survey taking capability

13.11 There has been a long standing need on the part of federal and provincial government departments for survey information substantially beyond the present capability of DBS. The DBS 5-year program includes allowances for a major expansion in DBS household survey capability beginning with the year 1970-71.

Research, Analysis and Projections

13.12 To evaluate and meet users demands for more detailed, reliable, timely, and sophisticated statistics, as well as for projections of various sorts, in the light of opportunities provided by the computer, it is necessary for a modern statistical office to utilize the skills of econometricians, regional analysts, demographers, economists and other subject matter experts. DBS has recruited small but competent staffs of such experts and it is planned to strengthen them during the next several years. The line between estimation and projection, production of statistics and analysis is shifting and becoming more ambiguous. Thus it is planned to review related activities in user government departments in the areas of projection, model building and statistical analysis, with a view to determining the role that the statistical agencies should play in the contemporary world.

Utilization of Administrative Records

13.13 Ways and means must be found for satisfying the demands for more statistics and for more sophisticated uses of statistics without corresponding increases in the burden on respondents and costs to governments. One of these would be to provide DBS with fuller access to administrative records for statistical purposes. Such access would facilitate studies and experimentation designed to develop new data or replace portions of certain DBS surveys with data from administrative sources.

Automation

13.14 The DBS must maintain its regular operations and embark on additional statistical programs with the technology and procedures immediately accessible, at the same time as it strengthens the foundation for rendering its operations more efficient and for converting to modern automated procedures on a broad front. The acquisition of a new computer will require the re-orientation and further training of many members of both the data processing and the subject matter staffs. This major effort must be made while, at the same time, the quality and timeliness of current DBS services to the public are fully safeguarded. To operate the new installation effectively, the present staff of computer system analysts, programmers and processors will have to be strengthened. The first stages of the training program required for this strengthening are already in progress, and second stage plans are well advanced. The assistance of qualified consultants will be required to aid in this training and also to aid in the development of a set of detailed data processing standards to control the technical practice and performance of the new installation. It is this new installation which provides the foundation on which DBS is developing a comprehensive plan for automating major portions of its operations over the next few years.

Mathematical Activities

13.15 The successful shifting towards much greater reliance on automated procedures also requires a good supply of mathematical statisticians who are called upon to redesign surveys and participate in the development of the methodology and specifications for automated survey procedures. Mathematical statisticians are, at any rate, needed to take advantage of modern statistical methodology and to introduce quality control and efficiency measures in the processing and tabulating of statistics. DBS already has a small but strong group of such officers, having developed a long-term plan several years ago to augment substantially its corps of mathematical statisticians. About 60 per cent of this plan, which will take another four years to complete, is now implemented.

Systematic Planning

13.16 Since it usually takes many years to develop a reliable set of statistics, it is necessary for the statistical agency not only to keep abreast of demands as they develop but to anticipate them and to try to put itself in a position for acting quickly and effectively when the anticipated demands materialize. Furthermore, it is necessary for a statistical agency to perceive the implications of new technological and intellectual developments and adapt its programs accordingly. The development of systematic long-range planning involves an improved system for setting priorities.

13.17 The establishment of priorities and planning activity has existed for a long time in DBS in a less formal way than is now necessary. Accordingly steps have been taken to establish a small but highly competent central staff whose specific duty will be to develop and guide the implementation of a comprehensive planning system suitable to DBS, in order to promote the most effective and efficient utilization of resources, in the light of the massive contemporary needs for information.

Management Cost and Program Reporting System

13.18 It has been decided to establish a generalized management cost and progress reporting system specially suited to DBS. It is expected that it will yield useful information on resource accounting, cost accounting and systematic budgeting, which will be used for program planning, reporting and control. The system will be integrated with current government accounting and program review and estimates procedures.

Professional Training and Career Development

13.19 A number of training programs are at present under way in DBS, complementing those being sponsored by the Public Service Commission, but a comprehensive training plan specially designed for professionals in a statistical organization and the integration of such a plan with their career development is yet to be evolved. The difficulties of working out

such a program are enhanced by the diversity of disciplines utilized in DBS and by the pressures of work placed on senior professional staff, but these difficulties do not diminish its importance. The program would have to accommodate the orientation needs of junior people and to fill gaps in the background of more senior people resulting from technological change. The program would probably have to include systematic rotational assignments and be tied to the re-orientation and training activities being developed in connection with the new computer installation. An important objective of the program would be to augment the attractiveness of professional jobs in the production of statistics. Although the process of producing reliable and timely statistics contains many aspects which are extremely challenging intellectually, in general the work of producing statistics is less appealing to university graduates, than that of using them. Yet, in order to achieve the objective of meeting contemporary requirements for statistics it is essential that the statistical production process should be in the most competent and dedicated hands. The development and implementation of the type of professional and career development program being envisaged will undoubtedly involve substantial assistance from experienced university professors who are familiar with DBS. It is planned to secure such assistance.

PART III

APPENDICES

APPENDIX 1PERSONNEL OF THE DOMINION BUREAU OF STATISTICS

This Appendix provides information on characteristics of DBS professional staff. Since the Dominion Bureau of Statistics as a whole is involved in scientific activities, all the data presented refer to the DBS as one entity.

1. Establishment and Personnel on Strength, by Category of Personnel
See Table 1 below.

For the purposes of this brief, professional staff are defined as including all DBS personnel in the Scientific and Professional Category and a small number of senior DBS officers who are listed under an Executive heading in some of the attached tables. Three of the professional groups of the Professional and Executive Category are represented in the DBS. These are the Mathematics group, the Library Sciences group, and the Economics, Sociology and Statistics group, with the latter group having by far the largest population. The Public Service Commission has published the following definition of the Economics, Sociology and Statistics group.

Positions included in the group are those that require the application of a comprehensive knowledge of economics or sociology in the performance of one or more of the following duties:

- The conduct of fundamental or applied research in economics, econometrics, demography and sociology.
- The planning, collecting, processing, analysis, evaluation and presentation of information, including the development and application of statistical concepts in the design of procedures for these purposes.
- The planning, development and evaluation of projects, programmes or policies having economic or sociological consequences.
- The writing and editing of papers and reports.
- The provision of advice regarding the economic or sociological implications of projects, programmes or policies.
- The supervision or direction of any of the above duties.

The Commission has also prescribed the minimum qualifications for members of the Group:

University graduation with a comprehensive knowledge of economics or sociology, or university graduation with a comprehensive knowledge in a discipline related to the duties of the position and a number of years of related experience in which the knowledge has been acquired to do work equivalent to that expected of a specialist in economics or sociology. For some positions, university graduation and a knowledge of statistical theory and methods may be accepted in lieu of a comprehensive knowledge of economics or sociology.

A large number of DBS staff are classified with the Administrative and Foreign Services Category and the Technical Category and many of these are also highly qualified academically. In the first category university graduation is normally one of the alternative minimum qualifications. In the Technical Category, the Social Science Support Group accounts for the majority of DBS staff. In the Bureau this Group is mainly responsible for the "conduct of surveys, studies, projects and tests requiring a practical knowledge of the specialized field." The minimum qualification is now two years of post-secondary school education.

2. Administrative Duties of Professional Staff

Thirty-five of the 417 professional staff on strength on 30 September 1968 (8.4%) carry out executive functions in their capacity of Assistant Dominion Statistician, Director general or Directors and, as such are considered to be primarily engaged in the management of scientific activities. This managerial group is assisted on administrative functions by administrative officers and other support personnel.

Table 1. Establishment and Personnel on Strength, by Category and Group

Occupational Category and Group	1968-69	
	On strength 30 Sept. '68	Estab.
Executive	7	8
Scientific and Professional:		
Economics, Sociology and Statistics	392	479
Library Sciences	4	5
Mathematics	14	22
	410	506
Administrative and Foreign Services:		
Administrative Services	64	79
Computer Systems Administration	93	110
Financial Administration	6	6
Information Services	12	13
Organization and Methods	15	16
Personnel Administration	17	20
Programme Administration	162	178
	369	422
Technical:		
Drafting and Illustrations	7	8
General Technical	3	3
Social Science Support	181	170
	191*	181
Administrative Support:		
Data Processing	195	216
Clerical and Regulatory	1,440	1,496
Office Equipment Operation	59	60
Secretarial, Stenographic and Typing ...	140	143
	1,834	1,915
Operational	6	9
TOTAL	2,817	3,041
Casuals (man-years)		408

* Pending classification conversion, a number of technical officers cover off professional positions.

TABLE 2a. Country of Birth, Secondary Education, Bachelor Degree of Professionals Having a Bachelor's Degree as a Final Degree

Bachelors' Final Degree	Country of Birth	Country of Secondary Education	Country of Bachelors' Degree
<u>Americas</u>			
Canada	205	212	224
Guyana	1	1	0
U.S.A.	2	1	7
West Indies	4	3	0
<u>Europe</u>			
Britain	24	22	20
Hungary	6	6	4
Czechoslovakia	1	1	0
Poland	3	3	0
U.S.S.R.	2	1	0
Belgium	1	0	2
Eire	1	1	1
France	0	1	3
Germany	2	1	0
Greece	1	1	0
Netherlands	1	1	1
Switzerland	0	1	1
<u>Asia</u>			
India	4	5	4
Burma	1	0	0
Hong Kong	2	2	1
Malaysia	1	1	0
Pakistan	1	1	0
<u>Middle East</u>			
Lebanon	1	1	0
<u>Africa</u>			
Egypt	4	3	2
South Africa	1	0	0
<u>Australia/New Zealand</u>			
	1	1	0
TOTAL	270	270	270

Table 2b. Country of Birth, Secondary Education, Bachelor Degree, Master Degree of Professionals Having a Master's Degree as a Final Degree

Masters' Final Degree	Country of Birth	Country of Secondary Education	Country of Bachelors' Degree	Country of Masters' Degree
<u>Americas</u>				
Canada	67	76	77	73
U.S.A.	1	1	4	33
West Indies	3	2	0	0
<u>Europe</u>				
Britain	10	10	12	7
Hungary	3	3	2	3
Poland	1	1	0	0
Romania	1	0	0	0
U.S.S.R.	4	1	0	0
Yugoslavia	1	0	0	0
Eire	1	1	0	1
France	0	0	0	1
Italy	0	0	0	1
Germany	1	2	1	2
Greece	4	4	1	0
Netherlands	2	1	0	0
Malta	1	1	0	0
Switzerland	1	1	1	0
<u>Asia</u>				
India	10	11	10	7
Ceylon	2	2	2	0
China	1	0	0	0
Hong Kong	2	2	1	0
Indonesia	1	0	0	0
Korea	1	1	1	0
Pakistan	2	1	1	0
Philippines	1	1	2	0
Taiwan	2	2	2	0
<u>Middle East</u>				
Israel	1	0	0	0
Syria	1	1	1	0
<u>Africa</u>				
Egypt	2	1	1	0
South Africa	1	2	2	0
TOTAL	128	128	121*	128

* 7 DBS professionals with a Master's degree do not have a Bachelor's degree.

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Table 2c. Country of Birth, Secondary Education, Bachelor Degree, Master Degree, Doctorate Degree of Professionals Having a Doctorate Degree as a Final Degree

Doctorate Final Degree	Country of Birth	Country of Secondary Education	Country of Bachelors' Degree	Country of Masters' Degree	Country of Doctors'
<u>Americas</u>					
Canada	3	4	4	4	3
U.S.A.	0	0	1	2	6
West Indies	2	2	1	0	0
<u>Europe</u>					
Britain	0	0	0	1	0
Hungary	6	6	3	2	5
Poland	2	1	0	1	0
U.S.S.R.	1	1	0	0	0
Belgium	0	0	1	1	2
Germany	0	0	0	0	1
<u>Asia</u>					
India	4	4	4	4	1
Burma	1	1	1	0	0
Australia/ New Zealand	0	0	0	0	1 .
TOTAL	19	19	15*	15*	19

* 4 of 19 DBS professional with a Doctorate degree do not have a Master's degree and 4 others do not have a Bachelor's degree.

Table 3. Average Age and Years of Employment From First Degree in DBS

	Bachelors'	Masters'	Doctorate
a. Average Age	37.6 yrs.	38.6 yrs.	42.7 yrs.
b. Average no. years employed in DBS	8.3 yrs.	5.7 yrs.	4.9 yrs.
c. Average no. years employed from 1st Degree	13.0 yrs.	14.0 yrs.	19.3 yrs.

Table 4. Age Distribution of Professional Staff by Classification

Classification	20-29	30-39	40-49	50-59	60+	Total	Average for Group
Senior Statistician and Senior Officer ...	-	1	5	8	-	14	51
Chief Statistician 2 ...	-	4	12	5	1	22	45
Chief Statistician 1 ...	-	7	15	10	1	33	46
Economist/Statistician 5	1	24	28	12	1	66	43
Economist/Statistician 4	3	29	26	11	5	74	42
Economist/Statistician 1-3	110	52	26	10	3	201	31
TOTAL	114	117	112	56	11	410	38

Table 5. Years Since First Degree of Professional Staff by Classification

Classification	0-4	5-9	10-14	15-19	20-24	25-29	30+	Total
Senior Statistician and Senior Officer ...	-	-	1	1	2	5	4	13
Chief Statistician 2 ...	-	3	1	8	4	2	4	22
Chief Statistician 1 ...	-	2	4	7	12	5	4	34
Economist/Statistician 5	-	5	22	16	12	4	5	64
Economist/Statistician 4	1	13	18	18	10	6	8	74
Economist/Statistician 3	16	26	13	12	6	4	6	83
Economist/Statistician 2	36	15	6	1	1	3	1	63
Economist/Statistician 1	48	6	-	-	-	-	-	54
TOTAL	101	70	65	63	47	29	32	407*

* Three of the 410 professionals classified in tables 4 and 6 have no degrees.

Table 6. DBS Service of Professional Staff by Classification

Classification	Number of years employed in the DBS*							Total
	0-4	5-9	10-14	15-19	20-24	25-29	30+	
Senior Statistician and Senior Officer ...	-	1	2	4	5	2	-	14
Chief Statistician 2 ...	2	3	3	8	4	1	1	22
Chief Statistician 1 ...	9	8	6	4	3	1	2	33
Economist/Statistician 5	22	16	15	6	2	-	5	66
Economist/Statistician 4	44	19	4	2	2	2	1	74
Economist/Statistician 3	55	18	4	4	1	1	-	83
Economist/Statistician 2	55	6	-	1	1	-	-	63
Economist/Statistician 1	55	-	-	-	-	-	-	55
TOTAL	242	71	34	29	18	7	9	410

* Continuous service.

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Table 7. Official Languages Proficiency (Bilingualism)

	Bachelors'	Masters'	Doctorate	Total	Percentage
Mother Tongue "English" (proficiency in French)	20	11	2	33*	7.9%
Mother Tongue "French" (proficiency in English)	31	14	0	45	10.8%
Mother Tongue "Other" (proficiency in English and French).....	5	5	3	13*	3.1%
TOTAL	56/270	30/128	5/19	91/417	21.8%

* Of the 46 persons indicated as being "Bilingual" in French and English (other than the 45 of French mother tongue), there has been no official language test carried out on 11 of these and therefore their degree of bilingualism is not known. Of the remaining 35 that have been tested, 12 have achieved 3rd level of proficiency, which is considered reasonable bilingualism for most purposes; of the remaining 23, 9 are considered to be reasonably proficient or able to absorb instruction quickly, while the 14 who are left are mainly beginners in the learning of French.

Table 8. Professional and Total Staff 1962-63 to 1968-69

Fiscal Year	On strength as of 1 April		Professionals as percentage of total
	Professional	Total	
1962-63	239	1,817	13.1%
1963-64	243	1,797	13.5%
1964-65	246	1,884	13.0%
1965-66	284	2,034	13.9%
1966-67	306	2,236	13.7%
1967-68	344	2,381	14.4%
1968-69	413	2,817	14.5%

Table 9. Previous Employment by Degree

	Bachelors ¹	Masters ¹	Doctorate	Total
Other Federal Agencies ..	89	32	5	126
Industry	63	22	2	87
University (Staff)	3	20	4	27
Provincial Governments and Agencies	10	9	2	21
Others	23	14	3	40
Hired Direct from University	82	31	3	116
TOTAL	270	128	19	417

Table 10. Turnover of Professional Staff, 1 April 1962 to 15 November 1968

Fiscal Year	On strength as of 1 April	Annual additions		Annual separations		Annual net increase	
		Number	%	Number	%	Number	%
1962-63	239	13	5.4	9	3.8	4	1.7
1963-64	243	26	10.7	23	9.5	3	1.2
1964-65	246	59	24.0	21	8.5	38	15.4
1965-66	284	57	20.1	35	12.3	22	7.7
1966-67	306	85	27.8	47	15.4	38	12.4
1967-68	344	97	28.2	28	8.1	69	20.1
1968-69	413	51		36*		15	

* A detailed analysis of separations of DBS professionals during 1968 under five headings follows.

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Detailed Analysis of Separations of DBS Professionals
during 1968

Table 11a. Separations of Professionals in 1968 by Country of Birth

Country	Bachelors '	Masters '	Doctors '	Total
Canada	18	5		23
India	2	1		3
U.S.A.	2			2
Congo		1		1
Ceylon		1		1
Jamaica	1			1
Ireland	1			1
Latvia	1			1
Poland	1			1
United Kingdom	1			1
Hong Kong	1			1
TOTAL	28	8	0	36

Table 11b. Separations of Professionals in 1968 by Country of Last Degree

Country	Bachelors '	Masters '	Doctors '	Total
Canada	21	5		26
United Kingdom	2	1		3
U.S.A.	5	1		6
Belgium		1		1
TOTAL	28	8	0	36

Table 11c. Separations of Professionals in 1968 by Years of Service at DBS

Years	Bachelors '	Masters '	Doctors '	Total
Less than 5	19	5		24
5 - 10	3	2		5
10 - 15	1			1
20 - 25	1			1
25 plus	4	1		5
TOTAL	28	8	0	36

Table 11d. Separations of Professionals in 1968 by Class and Grade

Class	Bachelors '	Masters '	Doctors '	Total
Senior Statistician 1		1		1
Chief Statistician 2	3			3
Chief Statistician 1	1			1
Economist/Statistician 5	2	1		3
Economist/Statistician 4	8	1		9
Economist/Statistician 3	4	2		6
Economist/Statistician 2	5	2		7
Economist/Statistician 1	5	1		6
TOTAL	28	8	0	36

Table 11e. Separations of Professionals in 1968 by Reason for Separation

	Bachelors'	Masters'	Doctors'	Total
To post-graduate training	5	1		6
To university teaching ...	1	2		3
To other Government Departments	7			7
To Industry	4			2
To International Agencies	2			2
Deaths and Retirements ...	6	1		7
Rejections and Abandonments	3	2		5
Other		2		2
TOTAL	28	8	0	36

Analysis of Staff Recruited During Last Five Years

Because over 50% of DBS professionals have less than 5 years of service with DBS, it was considered that a special analysis be made of this segment of the DBS professional population, which should be more representative of current trends:

Table 12a. Previous Employment of Staff Recruited (and still on strength) During Year Ending September 30

	1964	1965	1966	1967	1968	Total	Percent
Other units of the Federal Government	5	10	18	6	10	49	21.3
Industry	4	6	11	25	15	61	26.4
University (students)	7	7	17	17	23	71	30.7
University (staff)	2	-	1	4	4	11	4.8
Provincial governments ...	3	1	3	1	3	11	4.8
Other	3	3	8	8	6	28	12.0
TOTAL	24	27	58	61	61	231	100.0

Special Committee

Table 12b. Grade on Appointment for staff recruited (and still on strength) during year ending September 30

Classification	1964	1965	1966	1967	1968	Total
Non-professional grades ..	-	2	3	4	-	9
Economist/Statistician 1	10	9	23	31	28	101
Economist/Statistician 2	5	4	12	10	11	42
Economist/Statistician 3	6	8	9	11	4	38
Economist/Statistician 4	1	2	6	3	8	20
Economist/Statistician 5	2	2	3	1	6	14
Chief Statistician 1	-	-	1	1	4	6
Chief Statistician 2	-	-	1	-	-	1
TOTAL	24	27	58	61	61	231

Table 12c. Age Group at Time of Recruitment for staff recruited (and still on strength) during year ending September 30

Years	1964	1965	1966	1967	1968	Total
20 - 29	6	7	23	36	32	104
30 - 39	7	12	17	17	18	71
40 - 49	9	5	15	5	10	44
50 - 59	2	3	3	3	-	11
60 and over	-	-	-	-	1	1
TOTAL	24	27	58	61	61	231

Table 12d. Mother Tongue of staff recruited (and still on strength) during year ending September 30

Mother Tongue	1964	1965	1966	1967	1968	Total
English	14	22	36	41	35	148
French	3	-	8	5	9	25
Other	7	5	14	15	17	58
TOTAL	24	27	58	61	61	231

Education Leave for Professional Staff

In 1968-69, nine professionals were granted educational leave with some type of financial reimbursement. Periods covered ranged from two weeks for a certificate of course completion to 16 months for Ph.D courses. One officer obtained a Master's degree and three obtained Ph.D standing on

this basis during this period. In 1967-68, four professionals were allowed educational leave, two to obtain a Ph.D, one to obtain a Master's degree, and one to obtain a Diploma. In 1966-67, four professionals were allowed subsidized educational leave, one to obtain a Ph.D, two to obtain Master's degrees, and one to obtain a certificate.

Summer Employment of University Students

The following data refer to university students employed as professionals or in close support of professionals. Others are hired but employed as clerical help on the same basis as normal casual help.

Fiscal Year	No. of students
1962-63	12
1963-64	20
1964-65	28
1965-66	39
1966-67	29
1967-68	36
1968-69	28

General Observations

Some 34% of DBS professionals were born outside Canada, and over 28% of them obtained their last degree outside Canada. About 60% of DBS staff have less than 5 years of service with DBS, and 80% of them are less than 42 years old. In the last five years 30% of additions to staff resulted from university recruiting, 26% of additions were experienced people coming from industry, while 21% came on transfers from other units of the federal government.

An analysis of separations for the current year indicates losses of 36 staff attributable on a proportionate basis as follows: 33% to deaths, retirements and rejections, 25% to post-graduate training and university teaching, 25% to other departments and international agencies, and 11% to industry.

Special Committee

Because of the large increase in the requirements for professionals at DBS in the last few years, it has not been possible to recruit all new additions from universities and to promote from within. It has been found necessary to obtain experienced professionals on the market from a wide variety of sources, including many from overseas sources.

DOMINION BUREAU OF STATISTICS ESTABLISHMENT

as of October 31, 1968

	Execu- tive	Profes- sional	Admini- strative	Tech- nical	Admin- Support & Op's	Total
	number					
Dominion Statistician ...	1		1		2	4
Information Division ...		4	7	5	5	21
Canada Year Book		5	7		17	29
Branch Sub-Total	1	9	15	5	24	54
Admin. Finance and Personnel	1	1	5		3	10
Financial Services			7		27	34
Office Services			7	8	149	164
Organization & Personnel			19		30	49
Branch Sub-Total	1	1	38	8	209	257
Operations & Systems						
Development Branch ...	1		3		5	9
Central Registers		1	2		35	38
Management Services			10		1	11
Central Programming			95		7	102
Tabulating Services			6		265	271
Branch Sub-Total	1	1	116		313	431
Integration and Develop- ment Branch	2		1		1	4
Central Classification		10			6	16
Regional Statistics		6		1	3	10
Sampling and Survey						
Research		28	2	9	18	57
Special Manpower Studies		5		1	2	8
Company-Establishment ..		5				5
Demographic Research ...		1		1	2	4
Econometric Research ...		8			6	14
Branch Sub-Total	2	63	3	12	38	118

DOMINION BUREAU OF STATISTICS ESTABLISHMENT - Concluded

	Execu- tive	Profes- sional	Admini- strative	Tech- nical	Admin- Support & Op's	Total
	number					
Socio-Economic Statis- tics Branch	1		3		3	7
Consumer Finance Research		5		2	6	13
Provincial Liaison & Consultative Services		4			2	6
Agriculture		24	2	1	87	114
Census		42	14	15	119	190
Education		16	2	2	20	40
Health and Welfare		34	4	17	91	146
Special Surveys		6	98	12	76	192
Branch Sub-Total	1	131	123	49	404	708
Economic Statistics Branch	1	1	1		4	7
Input-Output		9		1	6	16
Merchandising and Services		10	3	7	57	77
Manufacturing & Primary Industries		41	4	20	139	204
External Trade		14	30	1	221	266
Labour Division		19	4	5	115	143
Job Vacancy Survey		5	69		25	99
Prices		30	1	26	64	121
Transportation		26	5	10	63	104
Branch Sub-Total	1	155	117	70	694	1,037
Financial Statistics Branch	1		2		3	6
Business Finance		24	2	1	45	72
Financial Statistics Co- ordinator		3				3
Governments		21	1	10	23	55
Central Personnel Records		1	21		20	42
C.A.L.U.R.A.		11	24	6	71	112
Branch Sub-Total	1	60	50	17	162	290
Economic Accounts Branch	1	1	1		2	5
National Accounts & Productivity		54	3	12	35	104
Balance of Payments		13		3	38	54
Current Business Indicators						
Branch Sub-Total	1	68	4	15	75	163
TOTAL DBS	9	488	466	176	1,919	3,058

Appendix 2EXPENDITURES BY OPERATIONAL UNITS

The following table sets out the expenditures of the Dominion Bureau of Statistics for the fiscal years 1962-63 to 1967-68 together with the approved budget for the fiscal year 1968-69.

Due to a number of changes in the organization during the period, adjustments have been made in the figures in an attempt to provide more meaningful comparison on a year-to-year basis of expenditures of the operational units of the Bureau.

EXPENDITURES BY OPERATIONAL UNITS - DOMINION BUREAU OF STATISTICS

1 APRIL 1962 - 31 MARCH 1969

	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
	thousands of dollars						
The Dominion Statistician							
Office of the Dominion Statistician	43	44	46	51	51	52	58
Canada Year Book	261	199	270	233	403	402	422
Information	49	60	88	141	108	321	318
Sub-total	353	303	404	425	562	775	798
Central Services							
General Administration	98	135	55	64	170	517	575
Financial Services	93	106	115	141	152	199	213
Office Services	311	302	468	561	793	939	897
Organization and Personnel	70	71	138	151	237	323	364
Management Services	-	-	-	-	39	74	104
Central List of Establishments	-	-	107	136	140	171	205
Sub-total	572	614	883	1,053	1,531	2,223	2,358
Co-ordination, Integration and Development	181	211	294	377	613	876	1,096
Sampling, Survey Research	118	96	149	184	284	470	600
Sub-total	299	307	443	561	897	1,346	1,696

EXPENDITURES BY OPERATIONAL UNITS - DOMINION BUREAU OF STATISTICS - Continued

	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
	thousands of dollars						
Socio-Economic Statistics							
Administration	19	21	22	27	30	34	82
Agriculture	633	625	637	698	751	811	942
Education	168	179	213	267	282	272	332
Health and Welfare	830	834	871	961	1,112	1,239	1,477
Special Surveys	1,491	1,563	1,793	1,909	1,948	2,270	2,479
Sub-total	3,141	3,222	3,536	3,862	4,123	4,626	5,312
Economic Statistics							
Administration	-	-	-	-	-	-	133
External Trade	847	877	960	1,100	1,274	1,431	1,766
Labour	642	645	732	809	920	954	1,070
Manufacturing and Primary Industries	989	997	1,129	1,298	1,467	1,526	1,746
Merchandising and Services	252	251	319	342	573	623	621
Prices	419	423	424	475	625	795	1,020
Transportation and Public Utilities	364	326	309	346	511	663	758
Sub-total	3,513	3,519	3,873	4,370	5,370	5,992	7,114
Financial Statistics							
Administration	-	-	-	-	-	-	50
Business Finance	335	356	306	369	419	454	571
Corporation and Labour Unions Returns Act	26	266	332	401	578	792	401
Governments	280	295	337	411	487	369	475
Sub-total	641	917	975	1,181	1,484	1,495	1,888

EXPENDITURES BY OPERATIONAL UNITS - DOMINION BUREAU OF STATISTICS - Concluded

	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
	thousands of dollars						
Economic Accounts							
Administration	-	-	-	-	-	-	52
Balance of Payments & Financial Flows	169	180	206	253	287	324	449
National Accounts, Production & Productivity ...	349	459	567	608	786	937	1,140
Sub-total	518	639	773	861	1,073	1,261	1,641
Operations and Systems Development							
Administration	-	-	-	-	-	-	91
Central Programming	174	167	215	275	404	610	921
Tabulating Services	1,121	1,273	1,307	1,244	1,584	1,688	2,520
Sub-total	1,295	1,440	1,522	1,519	1,988	2,298	3,532
Census	1,556	1,377	1,104	1,788	9,503	2,057	2,370
Central Personnel Records System	-	-	-	-	103	402	696
TOTAL - DEPARTMENT	11,888	12,338	13,513	15,620	26,634	22,475	27,405

Appendix 3EXPENDITURES BY ACTIVITY

The expenditures of the Dominion Bureau of Statistics shown in this table have been adjusted to reflect more closely the cost related to particular areas of statistical activity.

The principal difference is that the total expenditure of the Operations and Systems Development Branch have been assigned to the areas for which the services were provided. Certain expenditures of the Central Services directly related to the statistical operations have been allocated to those areas.

As in the previous table, adjustments have had to be made to provide more meaningful year-to-year comparisons.

EXPENDITURES BY ACTIVITY - DOMINION BUREAU OF STATISTICS

1 APRIL, 1962 - 31 MARCH, 1969

Area of Activity	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
	thousands of dollars						
Dominion Statistician	43	44	46	50	51	66	58
Canada Year Book	262	202	273	262	407	405	422
Information Services	52	63	93	148	114	330	318
Sub-total	357	309	412	435	572	801	798
Central Services							
General Administration	125	167	83	77	179	537	618
Financial Services	109	121	129	155	160	217	232
Office Services	86	75	108	157	381	332	350
Organization and Personnel	71	73	141	156	240	331	372
Management Services	-	-	-	-	39	74	104
Central List of Establishments	-	-	130	150	153	190	270
Sub-total	391	436	591	695	1,152	1,681	1,946
Co-ordination, Integration and Development	164	225	307	388	702	1,034	1,486
Sampling and Survey Research	119	104	193	241	342	586	779
Sub-total	283	329	500	629	1,044	1,620	2,265
Socio-Economic Statistics							
Administration	19	21	22	27	30	34	82
Agriculture	697	673	682	732	801	888	1,049
Education	193	208	239	303	321	317	331
Health & Welfare	1,055	1,066	1,151	1,262	1,550	1,615	2,172
Special Surveys	1,452	1,436	1,649	1,978	1,868	2,151	2,446
Sub-total	3,416	3,404	3,743	4,302	4,570	5,005	6,080

EXPENDITURES BY ACTIVITY - DOMINION BUREAU OF STATISTICS - Concluded

Area of Activity	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
	thousands of dollars						
Economic Statistics							
Administration	1,095	1,132	1,242	1,359	1,602	1,797	133
External Trade	781	818	949	1,095	1,281	1,336	2,170
Labour	1,105	1,175	1,361	1,505	1,668	1,774	1,626
Manufacturing and Primary Industries	260	256	375	386	654	743	2,090
Merchandising and Services	528	544	563	520	702	894	689
Prices	442	411	397	429	610	783	1,075
Transportation and Public Utilities	4,211	4,336	4,887	5,294	6,517	7,365	888
Sub-total							8,671
Financial Statistics							
Administration	374	400	356	415	463	46	58
Business Finance	26	267	355	421	622	529	697
Corporations and Labour Unions	320	346	385	474	558	780	887
Governments	720	1,013	1,096	1,310	1,643	397	590
Sub-total						1,752	2,232
Economic Accounts							
Administration	203	215	237	281	322	37	54
Balance of Payments and Financial Flows	366	484	592	634	820	352	498
National Accounts, Production and Productivity	569	699	829	915	1,142	988	1,398
Sub-total						1,377	1,950
Census	1,896	1,747	1,383	1,999	9,719	2,325	2,543
Central Personnel Records System	45	65	72	41	103	477	826
Work for other Departments					172	72	94
TOTAL - DEPARTMENT	11,888	12,338	13,513	15,620	26,634	22,475	27,405

Subject group	Monthly or more frequently		Quarterly to annually		Annual		Biennial and triennial		Occasional		Total number of publications
	No. of publications	Approximate no. of pages	No. of publications	Approximate no. of pages	No. of publications	Approximate no. of pages	No. of publications	Approximate no. of pages	No. of publications	Approximate no. of pages	
General	4	104	2	36	6	1,703	2	165	28	2,731	42
General	4	104	1	16	4	1,625	1	154	4	544	14
Comprehensive Studies			1	20	1	44	1	31	22	2,002	23
Productivity Studies					1	34			2	185	3
Primary Industries	16	112	10	145	50	1,241			11	973	87
Agriculture	4	57	10	145	16	346			8	727	38
Fishing	2	34			11	347			1	124	13
Forestry	1	2			2	1			2	126	5
Mines	9	19			21	489			1	120	31
Manufacturing	46	261	11	140	158	3,427	2	28	10	757	227
General Survey	1	52	1	75	10	808			2	131	14
Beverages and Tobacco	11	69	5	48	26	460	1	24	4	197	47
Leather and Rubber Products	3	22			5	98					8
Textiles and Apparel	10	2	2	10	19	342					21
Food Products	3	20	1	2	11	234					15
Paper Products and Printing	3	4			7	238			3	234	10
Metal	6	32	1	4	17	252					24
Machinery and Transportation Equipment	3				13	171					16
Electrical Equipment	5	12	1	1	8	112					14
Non-metallic Mineral Products	5	7			12	164					19
Petroleum and Coal Products	3	14			4	194					7
Chemicals	3	5			13	166	1	4	1	195	18
Miscellaneous Manufactures	1				11	188					12
Transportation, Communications and Utilities	11	65	4	65	52	1,827			6	271	73
Air Transportation	1	14			2	32					3
Rail Transportation	2	8	1	19	11	422			2	18	10
Water Transportation	2	12	3	46	20	396					25
Pipe Line Transportation	2	14			8	501					10
Communications	2	9			2	52					4
Other Utilities					5	270			2	37	6
									2	218	9
Commerce, Construction, Finance and Prices	23	611	9	388	42	2,318	19	265	38	3,255	131
Business Conditions	3	33	3	36	6	198			4	472	16
Prices and Consumer Expenditure	3	66	1	4	16	233	19	265	18	1,255	22
Merchandising and Services	7	45	2	8	1	80			1	1,311	53
Construction and Housing	2	48			3	102			1	218	6
External Trade	5	392	2	332	5	1,402					12
International Travel	2	21			1	80					3
Balance of Payments and International Investments	1	8	1	8	1	60			3	374	4
Government Finance					10	243			3	625	13
Employment, Unemployment and Labour Income	8	109	3	88	8	544			20	1,225	39
Labour Force	1	8			1	93			9	375	11
Employment and Earnings	6	86	3	88	5	353			4	605	18
Unemployment Insurance	1	15			1	59			4	172	6
Employee Benefit Plans					1	60			3	73	4
Education, Health and Welfare	2	6			46	3,430	1	227	76	4,012	125
Education					20	840	1	227	30	2,124	22
Public Health	1	4			1	48			20	1,072	22
Hospitals					3	80			5	80	19
Vital Statistics	1	2			14	1,611			20	724	24
Judicial Statistics					8	618			1	12	8
Census					5	30			413	18,464	416
Inter-censal					5	30			11	408	16
1961 Census									278	13,705	278
1966 Census									122	4,351	122
Total	110	1,248	39	862	367	14,520	24	705	600	31,688	1,140

* Does not include publications of the 1956 Census, or translations of other publications.

APPENDIX 5

Selection of Papers and Studies Contributed by DBS Employees

This Appendix contains a selection of papers and studies prepared by employees of the Dominion Bureau of Statistics between 1955 and 1968. Most of these were published either in professional journals or by the Dominion Bureau of Statistics. The list is by no means complete but is designed to provide an indication of this aspect of the research output of the Dominion Bureau of Statistics.

1961 Census Monographs

Urban Development in Canada, L. Stone, Ottawa,
Queen's Printer, 1967.

Trends in Canadian Marketing, M.S. Moyer and G. Snyder, Ottawa,
Queen's Printer, 1967.

Historical Estimates of the Canadian Labour Force,
F. Denton and S. Ostry, Ottawa, Queen's Printer, 1967.

Trends and Factors of Fertility in Canada, J. Henripin, Ottawa,
Queen's Printer, 1968.

The Occupational Composition of the Canadian Labour Force,
S. Ostry, Ottawa, Queen's Printer, 1967.

Provincial Differences in Labour Force Participation,
S. Ostry, Ottawa, Queen's Printer, 1968.

Unemployment in Canada, S. Ostry, Ottawa,
Queen's Printer, 1968.

The Female Worker in Canada, S. Ostry, Ottawa,
Queen's Printer, 1968.

Incomes of Canadians, J. Podoluk, Ottawa, Queen's Printer,
1969 (forthcoming).

Geographic Composition of the Canadian Labour Force,
S. Ostry, Queen's Printer, (forthcoming).

Migration in Canada: Some Regional Aspects, L. Stone, Ottawa,
Queen's Printer, (forthcoming).

Internal Migration in Canada, M.V. George, Ottawa,
Queen's Printer (forthcoming).

Studies Prepared for or in Conjunction with the Economic Council of Canada

Population and Labour Force Projections to 1970,

Economic Council of Canada Staff Study No. 1, F.T. Denton,
Y. Kasahara and S. Ostry, Ottawa, Queen's Printer, 1964.

An Analysis of Post-War Unemployment, Economic Council of Canada

Staff Study No. 3, F.T. Denton and S. Ostry, Ottawa,
Queen's Printer, 1967.

An Analysis of Interregional Differences in Manpower Utilization
and Earnings, Economic Council of Canada Staff Study No. 15,

F.T. Denton, Ottawa, Queen's Printer, 1966.

Population, Family, Household and Labour Force Growth to 1980,

Economic Council of Canada Staff Study No. 19, W.M. Illing,
Y. Kasahara, M.V. George and F.T. Denton, Ottawa, Queen's
Printer, 1967.

Enrolment in Schools and Universities 1951-52 to 1975-76,

Economic Council of Canada Staff Study No. 20, Wolfgang M. Illing
(Economic Council of Canada) and Zoltan E. Zsigmond, Ottawa,
Queen's Printer, 1967.

Papers and Studies Prepared for Professional Associations or Published in Professional Journals

"Statistics and the Businessman", W.E. Duffett, The Commerce Journal, Toronto, February, 1959.

"How DBS Serves the Nation", S.A. Goldberg, The Canadian Chartered Accountant, October, 1957.

"Time Series Analysis by Electronic Computers: A Report on Some Recent Applications at the DBS", R.B. Crozier and W. Darcovich, Volume 28, Canadian Journal of Economics and Political Science, 1962.

"Price Indexes in a Social Accounting Framework", B.J. Emery and T.K. Rymes, Canadian Political Science Association Conference on Statistics, 1962 and 1963, Papers.

"Long-Run Changes in the Distribution of Income by Factor Shares in Canada", S.A. Goldberg (and F.H. Leacy, in parts), Studies in Income and Wealth, Volume 27, 1964.

"A Note on Seasonal Fluctuations in Canadian Expenditures", F.T. Denton Volume 30, Canadian Journal of Economics and Political Science, 1964.

"The Canadian Quarterly National Accounts - A Critical Appraisal", S.A. Goldberg, H.J. Adler, J.D. Randall and P.S. Sunga, Income and Wealth, Series XI, 1966.

"Problems in the Estimation of Industry Output in Current and Constant Dollars in Canada", Gordon J. Garston and David A. Worton, Studies in Income and Wealth, Volume 32, National Bureau of Economic Research, New York, 1968.

"New Productivity Measures in Canada", David A. Worton, Proceedings of the Business and Economic Statistics Section, American Statistical Association, Washington, 1965.

"Alternative Treatments of Imports in Input-Output Models: A Canadian Study", T.I. Matuszewski, P.R. Pitts and J.A. Sawyer, Journal of the Royal Statistical Society, Volume 126, Part 3, 1963, pp. 410-432.

"L'ajustement périodique des systèmes de relations inter-industrielles, Canada, 1949-1958", T.I. Matuszewski, P.R. Pitts and J.A. Sawyer, Econometrica, Volume 31, No. 1-2, 1963, pp. 90-110.

"Linear Programming Estimates of Changes in Input Coefficients", T.I. Matuszewski, P.R. Pitts and J.A. Sawyer, Canadian Journal of Economics and Political Science, XXX, No. 2 (May, 1964), pp. 203-210.

"The Impact of Foreign Trade on Canadian Industries 1956", T.I. Matuszewski, P.R. Pitts and J.A. Sawyer, Canadian Journal of Economics and Political Science, XXXI, No. 2 (May, 1965), pp. 206-221.

"Note on British Unemployment Statistics", D.J. Bailey, Applied Statistics, Volume IX, No. 1, 1960.

"Wholesaling in Canada", J.C. Brearley and M.S. Segall, published in Marketing in Canada, edited by Edward J. Fox and David S.R. Leighton, Richard D. Irwin, Inc., Homewood, Illinois, 1958.

"The Canadian Consumer Price Index: A Reply", A.D. Holmes, Canadian Journal of Economics and Political Science, May, 1964.

"Some Relationships Between Highway Price Indexes and the Value of Engineering Construction", C.M. Jones, Canadian Good Roads Association, Technical Publication 24, 1965.

"Patterns of Family Spending", I. McWhinney, Canadian Home Economics Journal, Volume 16, No. 3. September, 1966.

"Income Size Distribution Statistics and Research in Canada", S.A. Goldberg and J.R. Podoluk, Income and Wealth, Series VI, International Association for Research in Income and Wealth, Bowes and Bowes, London, 1957.

"Characteristics of Family Investments", J.R. Podoluk, Canadian Home Economics Journal, Volume 16, No. 3, September, 1966.

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Appendix 6THE STATISTICAL PRODUCTION PROCESS AS
ILLUSTRATED BY THE JOB VACANCY SURVEY

1. There are many interrelated links in the chain of events from the design of a questionnaire to the eventual release of the information. A major new survey, the "Job Vacancy Survey", which is in course of development, may serve as an illustration. Typically, the developmental work on a new survey starts after the need for the data to be provided by the survey is established. In the present illustration the Department of Manpower urgently needed data on job vacancies to assist them in several areas of planning and policy making. The first step is to translate an abstract concept, such as "job vacancy" into operational definitions which approximate sufficiently the desired concept (i.e. under what exact circumstances should a respondent report job vacancies): it is essential that the survey should ask for information which is "measurable" and reasonably well defined.
2. Although most economists agree that the lack of some measure of unfilled labour demand represents a serious gap in the network of economic intelligence, there has been little "hard" analysis, within a theoretical framework, of either the concept or uses of Job Vacancy statistics. The question of what should be measured for what purpose has many answers or, rather, has no clear-cut answer. In an ideal world it would be possible to move from theory to measurement to testing and refining of theory. In the imperfect real world one must select an operationally feasible definition in the light of very general and limited knowledge of the operations of the labour market.
3. This problem -- the lack of conceptual precision or theoretical underpinnings -- has implications which go beyond the purely definitional aspects of job vacancy surveys. It generates a great deal of uncertainty in respect to data use and therefore data input/output specifications. There is of course no purely "statistical", i.e. technical, solution to this problem of uncertainty but the survey design should, if possible, take it into account along with the more standard cost-reliability criteria.

4. Next the universe had to be defined, i.e. it had to be decided which are the precise sectors of the economy that will be surveyed. Lists for sampling purposes had to be secured (collated from different sources) to cover the "universe" which had been defined. The available list, which was prepared originally for use to collect employment information, contained all establishments and companies. It was soon found that the units in a company for which employment information is available do not coincide with the units for which job vacancy information is available. Consequently extensive field work had to be carried out: each larger company had to be structured into so-called job vacancy reporting units to ensure that units for which information is requested are capable of providing the job vacancy data. Accordingly, the files had to be re-structured to correspond to the practice of the company with respect to the job vacancy reporting units.

5. Next the methodology for the survey had to be designed. This included the problems of sampling, data collection, editing, estimation, tabulation and data retrieval and automation of the entire process. All these problems are interrelated in a complex way and it is the whole system that needs to be efficient with respect to the final reliability of the product and the cost of the whole operation. It was found, for example, that the method of data collection and the method of sampling had a close impact on one another. The survey was originally thought of as a mail survey but it turned out that even after careful preparation the returned questionnaires contained major errors of reporting. It was therefore necessary to develop a complicated sample design involving first a mail survey, followed by an interview survey carried out on a small subsample of the original mail survey sample. This design is based on three conditions; first, because response error is likely to be high in the mail phase -- the interview survey is used to correct response error. Secondly, because standard methods of imputation for non-response seem to be inappropriate, the interview phase will be used to provide direct estimates of vacancies for non-respondents. Thirdly, because it is evident even now that the analytical potential of job vacancy data will be greatly enhanced by a variety of additional labour market information -- although it is not evident yet precisely what form that information should take -- the interview phase is established to

provide a 'substantial survey capacity which could be used as a vehicle for the periodic collection of such information. The interview phase, is essential in the short-run -- to improve the reliability of estimates of job vacancies -- and potentially most valuable in the long-run -- to enhance the meaningfulness and usefulness of estimates of job vacancies.

6. The data processing system which was designed for the survey adhered to the principles of complete automation. The use of the computer had a major impact on the survey design. As already mentioned above, a list of the units of the population to be surveyed had to be created in machine-readable form and processes had to be created for the continuous up-dating of this list with respect to new companies, changes of address, changes of organization, etc. Next an automatic sample selection program had to be generated, capable of selecting the required sample for each survey. In this automated survey the addresses of the selected units are printed out, ready for transfer onto the questionnaires. The identification of respondents who fail to respond to the mail survey is carried out automatically as well as their follow-up. The data are subjected to a series of extensive edits consisting of checks for impossible or inconsistent returns and their correction. After this step the sample data are weighted and the mail survey results are "corrected" by the results of the interview subsample.

7. When the preceding work is completed the file is ready for the final tabulations. These may be of the "standard" type (the same tables after each survey), and provision may be made for special custom-made tabulations, suited to the special needs of particular users. This degree of general capability to retrieve special tabulations vastly increases the usefulness of the survey; instead of being the source of standard tables only it becomes a storehouse of information.

8. In sum, the entire complex system had to be designed as an efficient whole. As various phases of the process were developed and tested in more detail, as more was found out about the nature of the population surveyed, other phases of the survey had to be altered or adjusted until, through a series of successive approximations, an efficient whole was created, serving the needs of users.

9. The data generated from this developmental survey of job vacancies will not be immediately available to the general public. An extended period of analysis and research, using the total statistical output of the survey, will be required in order to determine how meaningful the data are and to establish in what form they will be useful. It is only after this essential programme is carried out that published statistics will be possible for this new body of statistical data.

Appendix 7DESCRIPTION OF THE GEOGRAPHICALLY REFERENCED DATA STORAGE
AND RETRIEVAL SYSTEM BEING DEVELOPED BY DBS

1. The census results represent one of the largest stores of information in the Bureau. A substantial number of tabulations are produced and published from it. In spite of this, the Bureau clearly cannot anticipate in its publication program all the information needs of its users. Hence a considerable number of requests have to be processed through special tabulations. DBS service capability in this respect was limited in the past mostly by two technical factors:

(a) The census data as stored on tape had been geographically coded to the traditional hierarchy of standard areas: enumeration areas, census tracts, metropolitan areas, municipalities, counties, electoral districts, provinces, etc. But very often the information required by a user relates to a non-standard area, such as an urban renewal area, a school district, a planning zone, etc. Such requests either were not processed or the user had to be satisfied often with crude approximations of the area for which information was required.

(b) Each tabulation request had to be programmed, tested, corrected, and so on, separately. This resulted in considerable costs for custom-made tabulations as well as substantial delays in the time between the request for a special tabulation and the provision of the required information.

It was in order to remove these limitations that the so-called Geographically Referenced Data Storage and Retrieval System (GRDSR) is being developed. GRDSR places the emphasis on making information available by user specified areas (as opposed to standard areas such as census tracts, enumeration areas and municipalities for which census data will continue to be provided in published form).

2. The system will consist of a set of operations for the automatic assignment of geographic coordinates to households in major urban centers and for the computer storage of corresponding data. It is designed to

provide the means for geographically cross-referencing different data files and for the retrieval and tabulation of any combination of census data for these urban centers by any user specified area (within the limits of confidentiality imposed by the Statistics Act). The system is designed specifically for larger urban areas for the 1971 Census. Less extensive, but similar capabilities are also planned for the remainder of the country.

3. The system will be so designed that retrievals for arbitrary areas can be effected without programmer intervention. All that will be needed to retrieve data is to name the desired data fields (such as age, sex, occupation, etc.) and the boundaries of the requested retrieval area (school districts for example or any other well defined bounded area). Computer processing will then select all the households which lie within the designated area as a first step. Then a generalized program will retrieve and tabulate the requested data fields for the given area.

4. The project involves the development of some revolutionary new concepts of data storage, retrieval and other techniques. At this point, however, one feature of it should be emphasized: the entire package of programs will be made available to interested and cooperating municipalities (and other interested users) hence putting these users into the technical position of creating their own urban information systems which would be entirely compatible between different municipalities and between the municipalities and DBS. Given that certain municipalities would have developed their own (probably disparate) information systems, this project is thought to represent a potentially major saving for Canada and a potentially major achievement of standardization.

This project is now well along the way, most of its conceptual features having been tested successfully.

ANNEX APRESENT DBS SURVEYS OF SCIENTIFIC ACTIVITIES1. Introduction

1.1 The Dominion Bureau of Statistics now has two regular surveys of research and development, one concerned with Canadian industry and one with the Federal Government. Both cover only the life and physical sciences. In addition to these surveys, the Bureau is also involved in a number of other statistical projects in this area. Besides the DBS, several Government departments or agencies which sponsor or perform R & D also generate some statistical data as a guide to their own programmes.

1.2 A small section within the DBS, the Scientific Activities Surveys Section of the Business Finance Division, is responsible for the measurement of the resources devoted to scientific research and related activities. Prior to the section's establishment in 1965, surveys of scientific activities were carried out by a statistician in the Planning and Development Section of the same division. The section now has a strength of three: one statistician, one technical officer and one statistical clerk. The biennial survey of industrial R & D is carried out by the statistician and clerk, the annual survey of the scientific activities of the Federal Government is the responsibility of the technical officer, under the direction of the statistician. Two additional positions have been allocated in the 1969-70 fiscal year.

2. The Survey of Industrial Research and Development

2.1 This survey was begun in 1956, primarily at the request of the National Research Council, which actively assisted in all phases of the preparation. Although originally intended only as an ad hoc or single survey, so much interest was expressed in the results that it was decided to conduct the survey every two years. The present survey is therefore the seventh. Information resulting from the survey is published in the series "Industrial Research and Development Expenditures in Canada".

2.2 Rather than attempting to describe the questions typically asked in these forms, we have attached copies of the latest questionnaires used. It will be noted that the principal questionnaire (white) is divided into three areas: expenditures on R & D (questions 1 - 11), manpower associated with R & D (questions 12 - 14) and indications of the size of the respondent (questions 15 - 16). An annex is also sent with the principal questionnaire primarily to collect descriptive information. The contents of this yellow annex fall into two groups: the questions on pages 1 and 2 requesting identification of the respondent and those with which it is involved in R & D, and the questions on pages 3 and 4 concerned with some special aspect of their R & D. This second group of questions is changed for every survey.

2.3 An attempt is made to include all firms which perform R & D in Canada or which support the R & D performed by others. We are confident that there can be only a few companies with relatively minor expenditures which are missed in any survey. A register or list of R & D firms is maintained and continuously up-dated. The basic list is made up of firms known to have been doing R & D from the preceding survey. New names are secured from two types of source: articles or advertisements in newspapers, trade journals and popular science reviews, and government departments and agencies supporting industrial R & D. In addition, a number of companies are tentatively added before each survey as a result of a preliminary inquiry of firms not known to be engaged in R & D but which seem to be capable of performing R & D. In 1968 about 1,600 companies received questionnaires, but it is expected that only 900 - 1,000 of these are actually engaged in R & D. Usable returns have so far been received from over 700 of these R & D firms and estimates will be prepared for the remainder.

2.4 Several sources of information are available for verifying returns or for estimating for non-respondents. One is the returns from the preceding survey. Another is information from pages 1 and 2 of the annexes of the questionnaires submitted by other firms. Information provided by departments and agencies in the survey of the Federal Government is also used, as well as that secured from articles in newspapers, trade journals and popular science reviews.

2.5 Although reasonably satisfied with the quality of the statistics provided in relation to the DBS resources committed, we recognize that substantial improvements could be made. The basic data submitted by the respondents might be improved if we were able to carry out a programme of personal discussions with the company officers who actually complete the questionnaires. This would enable us to ensure that our definitions and instructions were being correctly interpreted. At the moment we cannot be certain that all respondents understand our questionnaires.

2.6 There are also certain weaknesses in the statistics as a time series. The data are not strictly comparable from survey to survey, both in total, and, in some cases, by industry. This is caused by variations in the returns of some companies, by estimates (required because of non-response) which are subsequently shown to be incorrect, by changes in ownership and reporting procedures of some companies between surveys, and, to a minor extent, by the omission of a few small firms from earlier surveys. This situation could be improved by the assignment of resources to examine the return of each reporting unit after every survey and compare them with previous returns, making adjustments as required for earlier years. Annual surveys, besides providing more frequent and more timely data, would also reduce the problems caused by the factors noted above.

2.7 In addition to improvements in the data now collected, there are also possible improvements in the scope of the surveys. Industrial R & D is of interest mainly because it is normally a prerequisite for the introduction of the new products and processes required for economic growth. However, it is only one aspect of the innovation process. For example, one estimate⁽¹⁾ of the typical distribution of costs in successful product innovation is the following:

R & D	5 - 10%
Product design and engineering	10 - 20%
Tooling and manufacturing engineering	40 - 60%
Manufacturing start-up	5 - 15%
Marketing start-up	10 - 25%

(1) Panel on Invention and Innovation, Technological Innovation: Its Environment and Management, U.S. Department of Commerce, 1967, p. 9.

Mr. Maxwell Weir Mackenzie has already noted this in this testimony before the Committee. Hence it would be useful to have statistics on the more costly phases of innovation as well as on R & D.

3. The Survey of the Scientific Activities of the Federal Government

3.1 This survey was started in 1959, also at the request of the National Research Council. Initially biennial, the survey is now carried out annually. The results of six surveys have been published, five in the series "Federal Government Expenditures on Scientific Activities" and one as a supplement to the DBS Daily (Supplement No. 4 of October 1967).

3.2 A copy of a recent questionnaire is attached. As in the survey of industrial R & D, information is requested on both expenditures and manpower. This survey, however, covers more scientific activities than just research and development. Besides R & D, financial data are requested for scientific data collection, scientific information, testing and standardization, and scholarship programmes. It is probable that another activity, engineering and feasibility studies, will be added in the next survey.

3.3 About 45 reporting units are surveyed: government departments, branches and agencies. Individual respondents range in size from those with very large programmes such as the National Research Council, to those spending less than ten thousand dollars on scientific activities such as the National Energy Board. Commercial-type crown corporations such as Polymer Corporation and the Canadian National Railway are included in the industrial survey.

3.4 It is often difficult to find additional sources of detailed information to use for the verification and editing of returns. The Estimates and Public Accounts give certain maximum limits of expenditures and sometimes the expenditures on individual programmes. Returns can also be checked against those for previous years. Department or agency reports prepared for the Royal Commission on Government Organization and for this Committee are very valuable. It is also relatively easy to contact the persons who actually complete the units' returns.

3.5 The statistical information resulting from this survey is recognized to be not entirely satisfactory, mainly for reasons beyond the control of the DBS. Government accounting records are not in a form which permits automatic identification of resources devoted to scientific activities. Accurate reports are, therefore, very much a matter of personal interpretation of the definitions and the respondent's knowledge of the organization's work. In the past there have been wide variations in the data reported in consecutive surveys. These are discussed with respondents, and, if necessary, earlier data are revised in order to ensure comparability. It might be noted that there seem to be substantial discrepancies in some cases between the departmental estimates prepared for this Committee and those supplied to the DBS. Since the only difference between the definitions of Committee's guidelines and those of our questionnaires is that the guidelines' definitions include the social sciences, these discrepancies must be due to some difference in interpretation. We are now attempting to determine the reasons for individual differences.

3.6 The value of the statistical information provided by these surveys would be increased if we had an organizational and descriptive directory of scientific units. Besides indicating the structure behind the statistics this would also provide a better indication of the type of work being done than can any purely statistical description. Such a directory would, hopefully, reduce variations in reporting due to changes in interpretation of DBS definitions. The information contained in departmental briefs for this Committee may provide a good foundation for this directory.

4. Other DBS Projects in Science Statistics

4.1 The Education Division of the DBS has several surveys of Canadian universities and colleges. One of these, concerned with the income and expenditures of the universities, collects estimates of "assisted research". Other surveys provide some data on education in the sciences. The two publications of interest in this area are Canadian Universities, Income and Expenditure, and Survey of Higher Education, Part II: Degrees, Staff and Summary.

4.2 Besides the two surveys described in Sections 2 and 3, the Scientific Activities Surveys Section has a number of other projects. One is a biennial survey of provincial research councils and foundations. Because there are only seven such organizations, this survey is carried out with the same forms used in the industrial survey. Results of the survey are normally published in a section of the report Industrial Research and Development Expenditures in Canada.

4.3 The section also co-operates in the surveys of other agencies. Recent examples are the Department of Industry's Directory of R & D Establishments project and some of the Science Secretariat's surveys for their special studies. Co-operation may take several forms. In some cases it consists only of advice on definitions and questionnaire design. In others the DBS also mails and receives the questionnaires, then forwards them to the agency concerned.

4.4 Special tabulations of the data received in the two regular surveys are also made for other departments, notably the Department of Industry, the Science Secretariat and the Economic Council. The section also arranges and tabulates information supplied by other departments so that they can make comparisons with our more complete statistics. Co-operation is particularly close with the Department of Industry in this area.

4.5 The section is also associated with the statistical work of the O.E.C.D. For example, it has participated actively in the revision of the O.E.C.D. manual "Proposed Standard Practice for Surveys of Research and Development". It also prepares the Canadian returns for O.E.C.D. international surveys of research and development. This last responsibility requires extensive co-operation with other agencies in order to prepare estimates for those areas not covered by existing surveys.

5. Other Government Sources of R & D Statistics in Canada

5.1 A number of other government departments provide statistics on R & D in their own areas of interest. The Department of Agriculture has

surveyed agricultural research in the Federal and provincial governments and the universities (1964) and also industry (1965). A report was issued of the results of the first survey in 1964.

5.2 The Industrial Research Adviser of the Department of Industry published an analytical report in 1967, Statistical Data on Industrial Research and Development in Canada. The DBS co-operated in the preparation of the report by providing data on Canadian industrial R & D. Some statistics, derived from the Department's administration of the Industrial Research and Development Incentives Act, are also published in the Annual Report on the Act. The Food Products Branch has "followed-up" the Department of Agriculture's earlier survey of industry and a report was issued in 1968 entitled Survey of Food Technologists in Canada.

5.3 Two reports containing statistical data have been published by the Medical Research Council. The first, Survey of Research Personnel in the Medical Sciences in Canada, 1965-66, was released in 1966. Canadian Medical Research: Survey and Outlook was published in 1968.

5.4 Because of its role as the primary supplier of funds for non-medical research in universities and colleges, one of the National Research Council's annual reports is an important source of statistics in this area. This is the Annual Report on Support of University Research. The Forecasting Committee of the NRC has also published more complete statistics in Expenditures on Research in Science and Engineering at Canadian Universities (1966).

5.5 Some of the Special Studies reports of the Science Secretariat are important statistical sources. This is especially true of Special Study No. 6, Background Studies in Science Policy. The statistical information in other reports of the series is concerned with narrower fields such as physics or psychology.

5.6 Inventories of research projects are compiled by some departments. Such inventories may have a certain statistical interest besides their obvious value to researchers and programme administrators. The Research and Statistics Directorate of the Department of National Health and Welfare has

at least three published inventories of research in its sphere of interest. The Medical Section of the Defence Research Board annually issues its "Reference List of Medical Research Projects in Canada". This inventory is distributed to Deans of Medicine, Science and Postgraduate Studies in Canadian universities, and to members of medical research advisory groups. The Department of Agriculture also has an annual report entitled "Inventory of Agricultural Research Projects". Two units of the Privy Council Office have also published inventories of research projects. The Special Planning Secretariat prepared the "Index of Federal Grants in Support of Extramural Research in the Social and Behavioural Sciences, 1967-1968" published in 1967. While not providing detail on individual projects, the Science Secretariat's special studies can usually be considered inventories in a general sense, since they often described current research in relatively small fields.

6. Future Developments

6.1 In future some machinery for the co-ordination of surveys of the sciences will probably be required. Up to the present, the different agencies which have surveyed R & D have generally attempted to ensure that definitions and concepts are roughly comparable. This has been due, largely, to the fact that only a few individuals and organizations have been active in this field, so that co-ordination and co-operation are generally a result of personal relationships. However, it seems desirable to establish more formal methods of co-ordination, especially since the number of surveys in this area are increasing. Not only will the various statistical series be more valuable if they are comparable, but it is essential to ensure that the good will of respondents is not abused by inappropriate questions or by several agencies asking for the same information. This co-ordination is a matter not only of definitions and questions, but also of timing and joint planning.

6.2 A possible future development of co-ordinated or co-operative surveys might be a common store of returns and respondent files. This would be a great aid in estimating for non-respondents and for compiling the type

of statistics appropriate for each agency. Not all files could be shared because of the secrecy requirements of some acts such as I.R.D.I.A. and the Statistics Act, but others could be made available to all agencies without violating the privacy of respondents.

6.3 An inventory of all units performing or funding scientific activities in all sciences would be extremely valuable, both as an aid to surveying and as an aid to the analysis of science statistics. This inventory could be confidential for the Business enterprise sector, if necessary, but published, or at least available to authorized personnel in science statistics and policy, for the other sectors. The inventory should include not only R & D units but also those active in the related scientific activities.

6.4 The following suggestions are based on the four sectors used in science statistics: General government, Business enterprise, Private non-profit and Higher education. They are also based on the premise that it is desirable to have statistics on all the sciences. In the General government sector, the life and physical sciences are now fairly well covered for the Federal Government, in aggregate, by the existing DBS survey. A programme is therefore required to collect data on support, both intramural and extramural, of the social sciences. A programme is also needed to provide statistics on the scientific activities of the provincial governments in all sciences.

6.5 Theoretically, present coverage of the Business enterprise sector is incomplete since the social sciences are not included, nor are non-R & D activities in the other sciences. However, there are major conceptual and technical difficulties in these areas. It may be more beneficial to attempt to measure the post-development phases of industrial innovation rather than to extend statistical coverage in these other areas.

6.6 The Private non-profit sector requires a great deal of work in order to define the sector and to identify the units involved before surveys of the sciences are practicable. It may be that while the sector certainly exists as a source of funds, as a performer it is inextricably linked with the Higher education sector. This seems to be true for the life and physical sciences, although it may not hold for the social sciences.

6.7 The Higher education sector is now inadequately covered, at least for non-medical research. No regular and comprehensive surveys of the total research performed in this sector exist. Since it is the source of future scientists and engineers, as well as the natural location for much of the nation's basic research, this is a serious deficiency.

ANNEX B

THE MEASUREMENT OF RESEARCH
IN THE
SOCIAL SCIENCES

A
memorandum
prepared by the

DOMINION BUREAU OF STATISTICS
January 1969

THE MEASUREMENT OF RESEARCH IN THE SOCIAL SCIENCES1. Introduction

1.1 This memorandum has been prepared by the Dominion Bureau of Statistics at the suggestion of Senator Lamontagne, Chairman of the Special Committee on Science Policy. The Bureau is pleased to comply with this request since, although it does not yet have any surveys in this area itself, it recognizes the urgency of initiating such surveys and, as a major social science agency, is interested in the information which would result. Furthermore, the DBS believes that it can contribute substantially to the discussion of the problems of measurement in the social sciences. Beside its breadth of experience in all types of surveys, it has, since 1956, had a small statistical programme concerned with the measurement of research and other scientific activities in the life and physical sciences. In fact, tentative plans have been made from time-to-time during the past two years to prepare for a survey of the social sciences. Unfortunately, because of other demands, these plans could not be implemented.

1.2 In the succeeding paragraphs it may seem that we raise an unnecessary number of problems and suggest relatively few answers. We believe, on the contrary, that if anything we minimize the difficulties which we can see in this area since adequate measurement of research in the social sciences will, in fact, be very difficult. Even if data-users and respondents were to co-operate wholeheartedly in such measurement, the fact remains that one is attempting to assign quantitative dimensions to an abstract activity. Hence it must be emphasized that it may take a relatively long period, perhaps 5 to 10 years, before we will have final, complete and comprehensive results, although valuable statistics will become available as the survey develops. The basic approach will probably be that of "successive approximations" to the real dimensions of the activity which we are measuring. It will be a process of continuously refining concepts, clarifying classifications, and providing more and more detail of the measured activities and the institutions in which they take place. Nor can the survey procedures for the life and physical sciences be considered exact

parallels. Besides the great differences between the two classes of science, we realize, as explained in Annex A, that there are serious deficiencies in the existing surveys of the life and physical sciences.

1.3 It seems desirable to co-ordinate any statistical programme intended to measure research in the social sciences with comparable programmes for the life and physical sciences, since the sciences tend to become increasingly interdependent, at least in their applications(1). Our surveys of scientific activities in the Federal Government indicate that respondents are finding it more and more difficult to identify projects by scientific field. Hence separate and unco-ordinated measurements may result in unreported activities or double-counting of research resources. A paper discussing a possible framework for such a co-ordinated statistical programme has been prepared for the research directors of the Committee.

2. General Background

2.1 In Canada, as in other countries, there seems to be now an increasing recognition of the need for some measurement of the activities of the social sciences as well as some quantitative description of the orientation of research in the social sciences. This is illustrated perhaps by some of the testimony the Special Committee has heard, as well as by some of the questions members have asked. This concern may become even more apparent as the hearings progress.

2.2 Many countries now have regular official surveys of the resources devoted to scientific research and related activities. As countries develop and refine national science policies these surveys have become increasingly comprehensive. However, except possibly in the Soviet Union and other socialist countries(2), the measurement of research activities in the social sciences has generally lagged behind the measurement of these activities in the life and physical sciences. Initially this was probably due to a relative lack of concern with the development of the social sciences but

(1) O.E.C.D., The Social Sciences and the Policies of Governments, Paris, 1966, pp 23-25.

(2) C. Freeman and A. Young, The Research and Development Effort in Western Europe, North America and the Soviet Union, O.E.C.D., Paris, 1965, pp 20-21

the present deficiencies are due largely to the inherently greater difficulties of measurement. The Organization for Economic Co-operation and Development has published an excellent international manual for surveys in the life and physical sciences(3), but neither the O.E.C.D. nor U.N.E.S.C.O. has yet prepared a similar guide for the social sciences. In spite of the more advanced state of surveys of the life and physical sciences, it should be recognized that there is still a great deal of work to be done to improve the quality and scope of the data before these surveys are entirely adequate for the needs of science policy.

2.3 It may be interesting to consider, briefly, the achievements of other countries in this field. At least eight member countries of the O.E.C.D. have some statistics on research in the social sciences (Belgium, France, Germany, Japan, the Netherlands, Norway, the United Kingdom and the United States)(4). Most of these countries only began to collect such data relatively recently and their surveys are still very much in the development stage. Not only do the different national series differ in coverage and quality, and hence are not comparable, but, since there is no recognized international practice yet, it is probable that they are often not attempting to estimate precisely the same activity. Most countries have not been able to measure social science research in the business enterprise sector.

3. Some Conceptual Problems

3.1 There are conceptual problems connected with measuring social sciences which are perhaps not so obvious when dealing with the life and physical sciences. The methodology and scope of the social sciences are probably less developed and defined than for the natural sciences. Indeed, at least one prominent social scientist (Claude Lévi-Strauss) denies that they are sciences. There are also substantial international differences as to which fields or sciences should be considered "social" sciences,

(3) Directorate for Scientific Affairs of the O.E.C.D., "Proposed Standard Practice for Surveys of Research and Development", Paris, 1964. This manual is now being revised.

(4) O.E.C.D., "Inventaire des ressources consacrées à la recherche en sciences humaines et sociales", DAS/SPR/68.38, Paris, 27 November 1968.

especially when attempting to distinguish the social sciences from the humanities. It may also be difficult to classify the discipline taught at universities, with the activities of the graduates in that discipline and their colleagues of different backgrounds. For example, is economics, as an academic discipline, the same thing as the work of "economists" in government and industry? Statistics, in the universities, would normally be classified as a natural science (mathematics); statistics, as applied in government and industry is often a social science or a tool of the social sciences.

3.2 Can "scientific research and development" be defined in the social sciences in the same way as in the life and physical sciences? The concept of development(5), in particular, requires clarification. Furthermore, although the scientific method of systematic observation, classification and interpretation may be followed in the social sciences, the application of the method differs. In the social sciences it may be much more difficult to distinguish between the collection of data and research since research typically depends on analysis of statistical-type data rather than controlled experiments. It may also be harder to demarcate the difference between social research and its applications, than between R & D and production.

3.3 In any case, the requirements of data-users will determine the data collected, subject to the resource constraints of the surveying agency and the data available from respondents. If one of the primary objectives of surveying the social sciences is to provide information for science policy, then activities other than research may also have to be considered. For example, information on the size and orientation of the activities of data collection, scientific information, education and the relevant social programmes might be just as necessary as the measurement of research. Similarly, if professional associations were to be primary users of the statistics, then information might be sought on all the activities or functions of social scientists.

(5) "the application of scientific knowledge in order to produce new materials, devices, products and processes, or to make technically significant improvements to existing ones."

3.4 The value of statistics on research in the social sciences may often be enhanced by studying them in conjunction with other statistical series. Hence it will be necessary to ensure that appropriate common concepts or definitions are used, especially since different units or agencies may be collecting many of the series. For example, assume that one wished to compare the number of professionals engaged in research in the individual social sciences with the total number active in the sciences. Common definitions are therefore required for "professional" and the individual sciences. Furthermore, it might be noted that what one wants, in most cases, is a measure of the value of the output of research. This does not yet seem possible and inputs (financial, manpower) are measured with the underlying assumption that in the long-run the size of the input will indicate the size of the output. However, the measurement of output is the ultimate goal and this, it seems probable, will involve comparisons of research statistics with other series.

4. A Possible Approach

What should be measured?

4.1 The individual social sciences must be identified and defined. This will involve the selection of the sciences (or fields of study) in which the potential data-users are interested - for example, there may be great interest in statistics of economic research but much less in those of linguistics. It may require a compromise between the classifications of sciences commonly used in the various types of institutions performing research and the classifications desired by policy-makers and other data-users.

4.2 Research is only one of a number of closely linked activities which are carried out by the same institutions and individuals. As noted above in paragraph 3.3, these other activities, for example, data collection, scientific information and education, may also be of interest to the data-users. But, in any case, because of their close connections with research, they will probably have to be measured simultaneously, and with equal diligence, in order to secure accurate statistics on research.

4.3 Normally, it will be necessary to classify research by performer, since this will, at the very least, help to indicate certain characteristics of the research performed. In the present statistical framework for the life and physical sciences, four performing sectors are identified: General government, Business enterprise, Private non-profit and Higher education. The individual sectors are often further divided, for example, statistics for the Business enterprise sector are often shown for different industries or industry groups. These sectors would probably also be appropriate for the social sciences.

4.4 The source of resources for research is also a desirable classification. Classification by source of funds is a well-established procedure in measuring the life and physical sciences - in terms of sectors it requires the addition of a fifth: Other countries. Classification by source of scientific manpower is not so common nor so easy. However, measurement of the flow of manpower between sectors would be of great interest.

4.5 Area of application of research is another important classification. Illustrations of areas of application of interest in the social sciences could be poverty causes and remedies, economic growth and urban development. One problem might be the reconciliation of the different interests of data-users and the selection of mutually exclusive areas of application.

4.6 The scientific staff engaged in research might also be classified by certain characteristics such as age, sex, training, level of education and function. Such a classification will depend on the interests of the data-users, modified, if necessary, by the records accessible to the surveying agency.

4.7 Throughout this section funds and manpower have been mentioned in connection with measurement. These are the two basic inputs which must be measured. Expenditures are either current (operating) or capital and must be distinguished. Personnel may be engaged either full-time or part-time in research. Data on both types of employment are important but the part-time employee must be converted to a full-time equivalent before estimating total manpower resources devoted to research.

4.8 Besides statistics on the resources currently devoted to research in the social sciences, certain other related statistics will be of value to data-users or will assist the surveying agency to verify and analyse data on research. Not all these would necessarily be publishable - some data might be confidential and of legitimate interest only to the surveying agency. Examples of related statistics (or descriptive information) are inventories of research projects, inventories or registers of scientists and records of salaries. The probable need for statistics on the activities related to research has been noted earlier. These related statistics or descriptive information may, in some cases, be the responsibility of other agencies. Here again it is desirable that, so far as possible, the collection of information is co-ordinated, both to ensure the comparability of different series and to minimize the work required of respondents.

How should the measurement be carried out?

4.9 The first step would be a preliminary examination of the project by the DBS and those organizations which have expressed an interest in this area. A rough assessment of the type of information which can be expected to result from the project must be made. If the existing, or anticipated need for this information is great enough, compared to other priorities, then the Bureau would agree to plan the preparation of appropriate surveys. Authorization would have to be secured for adequate resources to set up an initial small staff.

4.10 Once suitable staff have been engaged, there would be a phase of personal preparation. Since only one or two professionals would initially be involved, it is unlikely that this staff would be familiar with all the social sciences. Hence some background reading in the general literature of the individual social sciences might be required. This personal preparation would also entail study of existing government, university and business organizations, examination of the procedures and publications of other agencies collecting social science statistics, and informal discussions with officials of professional associations(6). A preliminary plan

(6) At least two associations, for example, have recent experience in surveying their professions with respect to research and other activities (the Canadian Sociology and Anthropology Association and the Canadian Psychological Association).

of procedure and conceptual framework could be prepared, as well as tentative operational definitions and criteria.

4.11 Once the Bureau staff have acquired an adequate knowledge of the subject and are prepared to make specific proposals, the project could then be formally and fully discussed with the user organizations. A large number of institutions would probably be interested. The Science Council and Secretariat, the Canada Council, the Department of National Health and Welfare, the Department of Manpower and Immigration, the Economic Council, the Treasury Board, the Secretary of State, the Social Science Research Council, the Humanities Research Council, The Canadian Council on Urban and Regional Research, the Association of Universities and Colleges of Canada, the Canadian Welfare Council and the professional associations are among those likely to have an interest in statistics of social science research. From discussions with representatives of these organizations we should learn what data are of interest to them and what compromises would be acceptable. They should also be able to provide advice on procedures and concepts. These organizations also represent, to a large extent, the institutions which are active in the social sciences. As much as possible it would probably be desirable to utilize a few small working groups rather than large conferences of all interested organizations.

4.12 The next phase might be an inventory of the various institutions active in the social sciences. Hopefully this inventory would indicate the institutions, their relationships with others and their approximate dimensions and characteristics. At the same time, the performance centres within each institution would have to be located, such centres being defined at the most elementary practical level. It would probably not be possible to prepare inventories of individual scientists, unless, perhaps, the inquiry were phased by scientific field or sector (sub-sector). The organizations mentioned above should help to secure co-operation, to interpret responses and to estimate for non-respondents.

4.13 If the results of the inventory phase are satisfactory, a great deal of interesting and publishable material will probably have been collected even at this early stage. The next phase might be a pilot survey of

representative institutions or performance centres. This pilot survey would have two objectives: to determine the representative characteristics and activities of different types of organizations and to test certain tentative definitions, questions, criteria and procedures. Besides being essential to the development of adequate surveys, the data collected through these pilot studies may also be publishable.

4.14 In the light of the results of the pilot surveys, the proposed procedures, concepts, definitions, criteria and questionnaires should be re-examined by the DBS and representatives of data-user and responding organizations. After this examination it should be possible for the Bureau to make definite proposals concerning a formal programme of surveys and statistical tabulations. The DBS could also calculate the resources required to carry out the suggested programme (and alternative programmes). Hopefully the early involvement of social science organizations will assist the DBS to obtain an adequate continuing response. Publication of some data obtained from the inventory and pilot survey phases may help to maintain interest in the project, and, possibly, even to generate additional enthusiasm.

4.15 It should be noted that there will probably not be a smooth and automatic progress through these several phases. During each phase it may become apparent that some plans must be modified and some compromise or "second-best" alternative accepted. Furthermore, not all the desired information may be collected initially - for example, a first survey might only be of one or two sciences in one sector. Nor does this procedure include the collection of any of the supplementary data mentioned earlier.

5. Some Anticipated Survey Problems

5.1 Based on DBS experience with surveys of R & D in the life and physical sciences, it seems probable that a major problem will be the correct location of the activity centres, the identification of their various administrative and legal affiliations, and the establishment of complete coverage without duplication. Initially, at any rate, individual scientists

will probably have to be contacted to determine their typical activity patterns and to prepare operational definitions and criteria appropriate for their type of unit. Both performing and funding units will be surveyed and asked to provide information in a form which, unfortunately, cannot normally be automatically extracted from their accounts. Hence it will be essential to have the support and co-operation of the scientific community.

5.2 Appropriate operational definitions will offer a challenge. It will be very difficult to frame definitions and criteria which respondents will read, understand and accept, overlooking, if necessary, their own personal notions of such activities as research. The timeliness of the published statistics will also present problems. The use of rapid data processing systems will help, but the editing of returns cannot now be mechanized since not enough is known initially. Even after the statistical material is available, the preparation of an acceptable analytical text, its translation and the printing of a publication typically takes several months at present.

5.3 It is not now possible to estimate the manpower and financial resources which would be required to maintain a complete survey programme and the inevitable special projects. However, the process of building up a competent staff is necessarily a slow one - time spent in training others is time not spent on research or operations - and, in any case, a programme such as that outlined in the preceding section is one which requires a very small staff initially.

Annex A "Present DBS Surveys of Scientific Activities".

Staff paper "Statistics and Science Policy" to be provided by H. Stead to the research directors of the Committee.

Dominion Bureau of Statistics, Ottawa, January 1969.



First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

The Honourable DONALD CAMERON, *Vice-Chairman*

No. 25

WEDNESDAY, FEBRUARY 5th, 1969

WITNESSES:

Economic Council of Canada: Arthur J. R. Smith, Chairman; David L. McQueen, Director; Andrew H. Wilson, former Secretary and Chief Research Officer of the Advisory Committee on Industrial Research and Technology, and now a member of the staff of the Science Council of Canada; and Fred Belaire, Secretary.

APPENDIX:

26.—Brief submitted by the Economic Council of Canada.

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Grosart	Nichol
Belisle	Haig	O'Leary (<i>Carleton</i>)
Blois	Hays	Phillips (<i>Prince</i>)
Bourget	Kinnear	Robichaud
Cameron	Lamontagne	Sullivan
Carter	Lang	Thompson
Desruisseaux	Leonard	Yuzyk
Giguère	McGrand	

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—
The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,
The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,
The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

CURRICULUM VITAE

Members of the Committee

BLOIS, HON. FREDERICK MURRAY, (Colchester-Hants). B. Mar. 30, 1893 at Gore, Hants Co., N.S. S. of Archibald Blois, English and Margaret Ann MacNeil, Scotch. Ed. at Colchester Academy. M. Oct. 6, 1914 to Grace Louise (dec. March 9, 1960) dau. of late C. Foster Cox of Truro, N.S. One daughter, Mrs. Shirley Blois Brown of New York City. Retired businessman. General Superintendent of Stanfields Ltd. forty years. Director of Stanfields Ltd., Electrical Distributors Ltd., C. F. Cox Ltd., Atlantic Electric Stores Ltd., and Colchester Broadcasting Co. Vice-Pres. Donato Faini & Figli (Canada) Ltd. Member Board of Gov. N. S. Research Foundation, Truro Town Council 1931-1937, and deputy mayor 1937-1945. M. L. A. Colchester Co. 1937-1945. Exec. Asst. Min. of Highways 1957-1960. Past. pres. Colchester County Hospital Trust; past chairman Truro Board of School Commission; past pres. Truro Rotary Club, Curling Club, Board of Trade, N.S. P.C. Assn.; past Grand High Priest, Royal Arch Masons, N.S., P.E.I. & Nfld. Mem. 1960 Can.-U.S.A. Inter-Parliamentary Committee and alternate del. 15th Session U.N. Serving on Financial and Budgetary Committee. First elected to N.S. Legis. at g.e. 1937. Re-elected g.e. 1941. Def. g.e. 1945. Opposition House Leader, N.S. Legis. 1939 and 1941-45. Summoned to Senate Jan. 14, 1960. Party pol. Progressive Conservative. Rel. Baptist. Address: P.O. Box 786, Truro, N.S.

CARTER, HON. CHESLEY WILLIAM, (). B. July 29, 1902, at Pass Island, Nfld. S. of W. P. Carter, and Sarah A. Rose, both British. Ed. at C. of E. School, Pass Island, Bishop Feild College, St. John's; Memorial University, St. John's; Dalhousie and King's University, Halifax. B.Sc. Degree, (Physics and Chemistry), M. Nov. 24, 1934, to Elsie Olga, daughter of Amos Webber, of Halifax, N.S. Three children: Norma Marie, (m. to Sidney Butler), Ann Webber and Allan William. Educationist; Supervisory Inspector of Schools, 1935-1940; Dir. of the Division of Adult Education and Audio Visual Aids of the Dept. of Education, Nfld., 1946-1949. Nfld. School Supplies 1949. Served overseas in Royal Nfld. Regt., from 1917-1919; after demobilization attended High School; taught school in Nfld. and N.S.; worked way through Coll., 1929-33, with assistance of scholarship. Served with Can. Army overseas in World War 2, 1941-46. Discharged with rank of Major. Great War Veterans' Assn.; Former mem. of the Executive. Former Chairman of Relief Comm.; Cathedral Men's Club. Organizer & Hon. Pres. War Veterans' Co-op. Society; St. John's Community Forum. Nfld. Ex. Officers Club, and Laurier Club, (Charter Mem.). First elected to H. of C. at g.e., June 27, 1949. Re-elected at g.e., 1953, 1957 (accl.), 1958, 1962, 1963 and 1965. Apptd. Parl. Sect'y. to Min. of Veterans Affairs, May 1963. Summoned to Senate, July 8, 1966. Party pol.: Lib. Rel.: Anglican Church of Canada. Address: Box N-366, St. John's, Nfld.

GIGUÈRE, LOUIS DE G., Born in Hébertville, Québec, on December 18th 1911. Educated at Chicoutimi and Sherbrooke colleges. Law, Social Sciences and Political economy at Laval University (1934-1937). Secretary-General of the *Institut Canadien des Affaires publiques* from 1954-1961. Director and member of an Executive Committee of Central Mortgage & Housing Corporation from 1963-1968. Administrator of the Building Materials Joint Committee and the Joint Committee of the Sheet Metal Industry for the Province of Québec. Member of the Canadian Nato Parliamentary Association, Canadian World Federalist Parliamentary Association. Director of Kruger Pulp & Paper Ltd., Les Laboratoires Octo Ltée, Campeau Corporation Town Heights Development (Florida). Summoned to the Senate on September 10th 1968.

HAIG, HON. JAMES CAMPBELL, Q.C., B.A., LL.D., (River Heights). B. June 2, 1909 at Winnipeg, Man. S. of Hon. John Thomas Haig, Can. and Josephine Michel Dickie, Scotch. Ed. at Univ. of Man. M. June 4, 1938 to Ellen Mary Margaret, dau. of Hon. Robert Jacob of Winnipeg. Three children: Jocelyn Michel (M. to B. B. Cassidy), John Robert and Jennifer Knight. A barrister-at-law. Dir. and sect'y. CJAY-TV, Winnipeg. Mem. Winnipeg Pub. School Bd. 1941-51, chairman 1950-51. Pres. Man. Society for Crippled Children and Adults, 1956-57 and Can. Council of Crippled Children 1959-60. Mem. Bd. of Regents United Coll. Winnipeg 1954-63. Man. Vice-Pres. Can. Bar. Assn. 1960-61. Mem. Man. Club, Winnipeg Winter Club, St. Charles Country Club, Winnipeg and Ottawa Hunt and Golf Club. Summoned to Senate June 15, 1962. Party pol.: P.C. Rel.: United Church. Address: 1004-99 Wellington Crescent, Winnipeg 9, Man.

MCGRAND, HON. FREDERIC, ADDISON, M.D.C.M., (Sunbury) Born July 5th, 1895, at Keswick Ridge, N.B. S. of Daniel McGrand and Rose Feeney, both Irish. Ed. at Provincial Normal School and McGill University. Degree: M.D.C.M. M. September 8th, 1929, to May, dau. of Mr. and Mrs. Robert Harkin, of Montreal, Que. Two daughters: Doris and Rose. A Physician. Served on Queens Co. Council, 1927-37; Warden, 1936-37. Elected to N.B. Legislature at g.e., 1935. Re-elect. g.e., 1939, 1944 and 1948. Apptd. Speaker, 1939 to 1944; Minister of Health and Social Services, 1944 to 1952. Organizer and President of Queen's-Sunbury West Memorial Hospital; Vice-Pres. of Can. Federation of Humane Societies. Summoned to Senate, July 28th, 1955. Party pol.: Liberal. Rel.: R.C. P.O. Address: Fredericton Junction, N.B.

NICHOL, HON. JOHN LANG, B. Comm., (Lion's Gate). B. Jan. 7, 1924 at Vancouver, B.C. S. of John M. Nichol and Sally Lang both Can. Ed. at Nemon, B.C., Vancouver, California, Royal Can. Naval Coll. and Univ. of B.C. M. April 21, 1951 to Elizabeth dau. of Kenyon Fellowes of Ottawa. Three children: Marjorie, Barbara and Sarah. A businessman. Served R.C.N.V.R., Lt. 1945. Mem. Advisory Bd. Salvation Army, dir. Vancouver Art Gallery, Governor Crofton House School of Vancouver, dir. Playhouse Theatre of Vancouver and pres. Lib. Fed. of Can. Summoned to Senate Feb. 24, 1966. Party pol.: Lib. Rel.: Anglican. Address: 5450 Marguarite St., Vancouver, B.C.

MINUTES OF PROCEEDINGS

Wednesday, February 5th, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 3.30 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Aird, Bourget, Cameron, Carter, Grosart, Haig, Kinnear, Lang, Leonard, McGrand, Nichol, Robichaud, Sullivan, Thompson and Yuzyk – 16.

In attendance:

Philip J. Pocock, Director of Research (*Physical Science*)
Gilles Paquet, Director of Research (*Human Science*)

The following witnesses were heard:

ECONOMIC COUNCIL OF CANADA

Arthur J. R. Smith, Chairman;
David L. McQueen, Director,
Andrew H. Wilson, former Secretary and Chief Research Officer of the Advisory Committee on Industrial Research and Technology, and now a member of the staff of the Science Council of Canada; and
Fred Belaire, Secretary.

In attendance:

Dr. David W. Henderson, Scientific Adviser; and Robert B. Crozier, member of the Council's staff.

(A curriculum vitae of each witness follows these Minutes).

The following is printed as Appendix No. 26:

Brief submitted by the Economic Council of Canada.

The Council has also submitted two additional Appendices in support of their brief: a reprint from the Fifth Annual Review, Chapter 3, entitled "Science, Technology and the Economy; and a report to the Council by the Advisory Committee on Industrial Research and Technology, entitled "A general incentive programme to encourage research and development in Canadian industry". These have been retained by the Committee as exhibits.

At 5.50 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

SMITH ARTHUR J. R. *Born:* Simcoe, Ontario, 1926 *Family:* Wife (née Ruth Carey of Hamilton, Ontario) Children—three daughters *Primary and Secondary School Education:* Coonoor and Ootacamund, India; and Simcoe, Ontario *Degrees:* B.A. (1947), McMaster University (Hamilton, Ontario) Mathematics and Political Economy M.A. (1949), Harvard University, (Cambridge, Mass.) Ph.D. (1955), Harvard University (Cambridge, Mass.) Economics *Home Address:* 1567 Featherstone Drive West, Ottawa 8, Ontario. Tel: 731-4861 *Previous Positions:* Teaching Fellow, Harvard University, 1949-50 Economist, Federal Reserve Bank of New York, 1950-54 Canadian Economist, National Industrial Conference Board, 1954-57 Lecturer, Extension Department, McGill University 1955-56 Secretary-Treasurer and Director of Research, Private Planning Association of Canada, 1957-63 Director of Research, Canadian-American Committee, 1957-63 Secretary, Canadian Trade Committee, 1962-63 Director, Economic Council of Canada, 1963-67 *Present Position:* Chairman, Economic Council of Canada (Office Address: Royal Trust Building, Ottawa, Ontario, Tel: 992-4288) *Member:* Science Council of Canada Social Science Research Council of Canada Agricultural Economics Research Council

McQUEEN, David L., Born Saskatoon, Saskatchewan, December 25, 1926. Education: Schools in Saskatoon, Kingston, Ont., Winnipeg, Man., University of Manitoba (B. Comm. 1947), Queen's University (M.A., 1948); London School of Economics (Ph.D., 1952). Employed Research Department, Bank of Canada, 1952 to 1965; Economic Council of Canada since 1965. Appointed Director of Economic Council 1968. Co-author with Y. Dubé and J. E. Howes of study *Housing and Social Capital* for Royal Commission on Canada's Economic Prospects, also, contributor to *La planification économique dans un État fédératif*, Laval University Press, 1965, and to *Wages, Prices, Profits and Economic Policy* (John H. G. Crispo, editor), Toronto, 1968.

WILSON ANDREW H. Born in Scotland, May 30, 1928. Educated at George Watson's College, Edinburgh, and the University of Glasgow. Graduated B.Sc. (mechanical engineering) in 1949 and M.A. (economics and mathematics) in 1954. Served a "sandwich" apprenticeship in marine engineering with Harland and Wolff Ltd., Glasgow, concurrently with University engineering studies. Served in the Royal Air Force, 1950-51, principally as a Technical Staff Officer at Headquarters, Coastal Command, Northwood, Middlesex, and attained the rank of Flying Officer. Design engineer (hydraulic equipment) with MacTaggart, Scott Ltd., Edinburgh, 1949-50. Sales engineer with the Skefco Ball Bearing Co. Ltd. (S.K.F.), Luton and Birmingham, England, and Cardiff, Wales, 1954-57. Came to Canada in 1957 and became a Canadian citizen in 1962. Senior mechanical design engineer with Atomic Energy of Canada Ltd., Chalk River, Ontario, 1958-60. Scientific administrative officer, physics Division, AECL, Chalk River, 1960-64. Secretary and chief research officer of the Advisory Committee on Industrial Research and Technology of the Economic Council of Canada

and member of the Council's staff, 1964-68. Science Adviser, Science Secretariat, Privy Council Office, September 1 to October 31, 1968. Science Adviser, Science Council of Canada, since November 1, 1968. Member of the Engineering Institute of Canada. Program chairman of the Chalk River Branch of the E.I.C., 1960-61. Member of the Association of Professional Engineers of Ontario. Member of the Institution of Mechanical Engineers, London, England. Member of the Canadian delegation to the Policy Conference on Highly Qualified Manpower of the O.E.C.D., 1966. Associated with the organization and administration of the International Conference on Nuclear Structure held at Kingston, Ontario, 1960, and with the International Atomic Energy Agency's Symposium on the Inelastic Scattering of Neutrons held at Chalk River, 1962. Author of research and background papers for the Economic Council and its Advisory Committee, including "Science, Technology and Innovation" (Economic Council of Canada Special Study No. 8), 1968. Author of several other published papers, including "The Chalk River Project" (Glasgow University Engineering Society, 1962) and a contribution, "Why Smash Atoms? ", for the AECL REVIEW, 1964.

BELAIRE, FRED. Mr. Belaire is a native of Ottawa. He attended the University of Ottawa where he obtained a B. Com (Business Administration) in 1956. He did post-graduate work in Economics at the University before joining the staff of the Dominion Bureau of Statistics in the Fall of 1957. During the next two years, he worked on problems associated with the seasonal adjustment of the National Accounts as well as of the Current Economic Indicators for the Canadian Statistical Review. In January 1960, he became the Economic Research Officer of the Liberal Caucus in Parliament. He joined the Prime Minister staff in the Spring of 1963 where he worked on the drafting of the Economic Council Act. Subsequently, as a Special Assistant to the President of the Privy Council, he worked on matters pertaining to the passage of the Council legislation through Parliament. Since January 1964, he has served on the staff of the Chairman of the Economic Council. On March 1, 1968, he was appointed Secretary of the Council. Mr. Belaire is married and has three children.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Wednesday, February 5, 1969.

The Special Committee on Science Policy met this day at 3.30 o'clock p.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, I am sure I speak on behalf of all my colleagues when I say we are pleased indeed to welcome the Chairman of the Economic Council of Canada, Dr. Arthur J. R. Smith. As you know, Dr. Smith has succeeded Dr. John J. Deutsch, who returned to Queen's University as its Principal.

Dr. Smith is accompanied by Mr. David McQueen, one of the three permanent directors of the Council; Mr. Robert B. Crozier, a member of the Council staff; and Mr. Andrew H. Wilson, former Secretary and Chief Research Officer of the Advisory Committee on Industrial Research and Technology. Mr. Wilson, who is now a member of the staff of the Science Council of Canada, is the author of a special study on science and technology which, I understand, in a way formed part of the background used for the special chapter in the last annual review of Economic Council of Canada.

Dr. Smith: Yes. I might point out that Mr. Wilson is now a member of the Science Council staff.

The Chairman: Thank you. Also present is Mr. Fred Belaire, Secretary of the Economic Council of Canada. I might add here a personal note, that he was also at one stage my assistant when I was Secretary of State and we were working together to set up the Economic Council.

As usual I am sure that you have prepared an opening statement, so we will start with that and then proceed to the discussion period.

Dr. Arthur J. R. Smith, Chairman, Economic Council of Canada: Yes. Mr. Chairman and honourable Senators, I would like to say a few words at the outset, if I may.

I was thinking in coming in here that the Economic Council is a new institution and it appears as a new

institution in old rooms. I was hoping that the appropriate analogy was not new wine in old bottles.

The council sent you beforehand a brief which outlined a few things about the Council, a few things that we thought were particularly relevant to your deliberations. We followed the guide lines which were provided in the terms of the information you wished to have.

I thought I might just take a few moments and expand on perhaps three of the themes in that brief as background to the questions.

It is, of course, a great privilege and an honour to have been invited to appear before this committee. The committee is dealing with many important aspects of what is perhaps the most important phenomenon of the modern age, namely, the explosion of knowledge - and with an industry, if one can call this an industry, that has I think undoubtedly become the most important industry in this country and various other countries by now, namely the industry involved in the production and consumption of knowledge. I thought that I might touch on one or two themes here that would indicate something about the role of the Economic Council, something about our concern with science and technology, and at least some of the economic aspects of science and technology as we dealt with them in our last annual review.

Then perhaps I could touch very briefly on some comments about the Council's research program.

First of all, as most of you are undoubtedly aware, the Council is a rather unusual institution. It reflects I think, in a very real way, some of the unusual features of this country: our unusually diversified regional interests across a very large continent; our unusually decentralized system of decision-making; and our unusually decentralized political system in terms of the sharing of a wide range of political powers between different levels of government and between two different sets of sovereignties.

The Council is first of all an unusual body because it has an unusually broad membership. Apart from the three full time members of the Council, the other twenty-five members are deliberately selected

to reflect the widest possible spectrum of interests from the private sector of the economy and the different regions of the country.

In approximate terms these members of the Council have been divided from the start into roughly four equal groups; about a quarter of them have come from the labour unions; about a quarter from industry, commerce and finance; about a quarter from the primary industries, agriculture, forestry, fishing and mining; and about a quarter in the general sense from the general public, to reflect consumer and public interests, including one or two university professors.

Secondly, the Council has been given unusually broad terms of reference; it has been asked to advise upon certain basic economic goals and upon policies that are relevant to these goals. It has been asked to study a wide variety of matters; it has been asked to consult various organizations; it has been asked to disseminate information, to promote productivity gains, to undertake special references and studies if requested to do so by the government. So there are a wide variety of duties and responsibilities given to the Council.

Thirdly, the Council is a body that is unusually independent of government, its creator. This is reflected in its membership. It is also reflected in the fact that the Council was given very considerable freedom in its act to publish; indeed, the Council may publish anything prepared for its use that it sees fit to publish.

Finally, the Council is unusual in the sense that, unlike many other national economic councils or planning bodies, it combines in a single organization two functions that are in most other places divided between institutions.

This was pointed out very dramatically recently, when Professor Tinbergen visited us and made a major point of the fact that in the Netherlands the basic work that is done on the research side, looking ahead in the Netherlands, is done in the Central Planning Bureau, which is part of the Department of Economic Affairs.

The results of that work then subsequently go to the Economic and Social Council, consisting of people from the labour unions, from business, and from the universities, who study and advise upon this.

Roughly the same kind of arrangement exists in various other countries: In the United Kingdom now, where the research work on the future has been taken inside the Department of Economic Affairs; in Japan, where you have the basic work done in the Economic Planning Agency, which is a government department, with the long term planning appearing

under the Economic Deliberation Council, composed of people from business, finance and the universities.

In the Economic Council of Canada, these two things are put together in a single institution. There are in fact so many ways in which the Council appears to be unusual that there are some people who might be disposed to think that it might be a rather queer institution, but it does seem to work. On the whole we at the Council have been encouraged by comments that have been made in various places by people who seem to find the work we do at the Council of some use.

Its effectiveness, I think, has been largely the result of people, particularly of the genius of its first chairman, John Deutsch, and the very distinguished members of the Council and the high quality staff which the Council has been fortunate enough to have.

Now let me turn for a moment to the question of science and technology in the economy, which we discussed in the Fifth Annual Review. This was not an attempt on the part of this Council to try to articulate some kind of science policy or a group of science policies for the country. That would not only be beyond the terms of reference of the Council, but I think, an exceptionally ambitious undertaking for such a body to attempt.

What we tried to do in this chapter was to look at certain economic aspects of science and technology in a rather broad sense.

— Let me focus attention for a moment on what is perhaps the principal theme of the Council's work in this field relating to the question of the relationship between science and technology and economic progress, growth and development. The Council, after considering this field very carefully, came to the central conclusion that the thing which needs to be kept most in focus in trying to find the links to economic progress is that it is not the creation of knowledge that is important in the economic context, it is the use of knowledge. It is not R and D activity that relates very closely to the economic growth and development of a country, it is the whole innovative process. It includes R and D at one end of the spectrum, but stretches very importantly to a whole series of different kinds of areas—in industry through the stages of design and development, engineering, tooling up, preparing for manufacturing, and preparing for marketing. This is all part of a very large innovative process, and knowledge is used along this whole spectrum.

In trying to discuss some of the issues involved here, the Council, of course, quickly became aware of the fact, as many others have, that this is a very complex process; it is a very difficult one to understand; it is one that is very difficult to identify and quantify in any precise way.

The Council pointed out that expanding use of scientific and technical knowledge plays a role in relation to many of the factors that bear on the economic growth of a country—that knowledge is involved in the process of shifts of resources from lower productivity, from less efficient to more efficient uses; that it is involved in processes that move the economy towards larger scales of production and increasingly specialized production, which may contribute to a productivity growth.

Then it is involved in the whole process of upgrading the quality of manpower and the quality of the capital used in the system, and in many other factors. Indeed, such knowledge acts and interacts with all of these factors to bring about economic growth.

I might say we have a great deal to learn about how innovation plays a part in economic progress. But the Council attempted to identify some of the areas in which there could be effects that would improve innovative capacity, the capacity of an economy to absorb new knowledge and use it effectively.

We pointed here to the importance of very high quality management, improved capacity in management to manage technological change, to manage the whole process of the innovation.

I think this is an area where there is scope for improvement in the Canadian economy.

Information, of course, is a basic input in the productive process, and therefore anything that can improve the access to, and diffusion of, knowledge can be very important in facilitating innovation.

We pointed also to the fact that if you want to have a highly innovative economy you must have an economy that is flexible and adjustable; it must have a capacity to adjust. Therefore, you must be concerned about various kinds of rigidities that may exist in the system, including institutional rigidities, that may impede smooth and effective functioning of capital markets, or labour markets, or other markets. You therefore need heavy emphasis on policies to facilitate adjustments to change: manpower adjustment policies; manpower mobility and training policies, for example. The Council also placed very important emphasis on the importance of competitiveness in the system. Competition is a force that can act as a major spur to the adoption and application of new knowledge in more effective ways. These are some illustrations of the issues that the Council placed emphasis upon in its review.

Let me turn now for a moment to the question of the Council's research program: One of the Council's main tasks is to look ahead over a number of years, over the medium-term future—over a period of, say, five to seven years—and ask what the Canadian economy is broadly capable of achieving on the basis of certain economic and social goals, which it

has attempted to define, and in some respects quantify and set up as targets. In short what is the potential of the Canadian economy?

The Council is not much interested in forecasting; it is much more interested in what we think we ought to set out to achieve, as a nation, over a number of years ahead in relation to the resources at our disposal, to visualize a Canadian economy operating at high standards of performance in relation to the goals of high employment, high growth, the maintenance of reasonable cost and price stability, balance of payments viability and to a situation in which, as the act says, all Canadians may share in rising living standards.

This is what the Council has been centrally concerned with, and in doing so it has attempted to monitor the future, to anticipate the problems that may arise, new opportunities that must be seized, some of the changes in policies that are required to make high standards of performance achievable in a consistent and sustained way in the future.

In approaching this task the Council has decided that it would not use each annual review simply to develop a new medium-term look ahead. It would do this from time to time. It did it in its *First Annual Review* and again in the *Fourth Annual Review*. In between such Reviews it would attempt to develop a growing understanding of some of the underlying economic relationships in the system, some of the areas of problems with a view to improving the Council's capacity over the time to do a better job in looking into the medium-term future, understanding more about some of the developments that are likely to occur, some of the relationships that will affect performance—that have affected performance in the past, and may continue to affect it in the future. In this way it would develop a growing understanding that would help to improve its policy advice because its main function is an advisory function.

May I illustrate this very briefly with the growth field. This, of course, has been one of the main fields of concern to the Council.

We started in the first Review to build what was a very primitive model of growth as a basis for attempting to view the appropriate growth potential of the Canadian economy for the period 1963 to 1970. We had to do that work in a great hurry, within a matter really of three or four months, in order to produce this in our *First Annual Review*. We knew it was primitive and rough.

After that was completed we went to work to look at growth much more carefully, to look at growth in Canada in comparison with growth in the United States, to look at levels of productivity, at income per capita in Canada in relation to that in the United States. We have broadened this work out to include

other countries besides the United States with a view to using these comparisons as a means for gaining a better understanding of why changes were taking place in certain ways.

We moved into the area of examining the sources of economic growth, the causes of economic growth. There have been many theories over the years as to why growth takes place. In fact, we really do not know very much about growth; it is a very complex process, so we have started to develop a program of research that would give us a better understanding of some of the sources of growth.

We looked at things like education and the role of education in relation to economic growth; the importance of skill and specialization; the kind of impetus those might give to economic growth, so that by the time we came to the new look ahead in the Fourth Annual Review we were able to do this in a more sophisticated way. In our developing program in growth we have made a beginning at still further elements of work that should bring still greater understanding over time.

We have, of course, made a beginning at looking at certain regional aspects of growth, in the same way in which we look at international aspects—the differences in growth between regions, the differences in levels of productivity and real income per capita between regions, in an attempt to begin to ask questions about sources of economic growth between different regions.

We have also had a look at urban growth, very much a beginning, in the Fourth Annual Review. Also we have made a very brief beginning at looking at rural growth and growth in the primary industries.

By the Fifth Annual Review we were in a position to take a much larger view of international comparisons of growth between Canada and European countries, as well as the United States. We also made a beginning there of getting below the highly aggregative approach to growth which had been the main focus up to then, to look at some aspects of the changing structure of the economy; and, in particular, we included a chapter on productivity growth in agriculture and some of the factors involved.

We hope over time to probe further into this sort of sectoral analysis, because it is obvious that growth does not proceed evenly on all frontiers of an economy. The very nature of growth is that it proceeds unevenly and we expect to find quite a lot of differences in the sources of growth and the factors contributing to growth in different sectors of the economy.

This will illustrate in a general way the evolution of a research program at the Council in one important area of its work. We have had, and we will continue to have, very important work in the regional

area. The fifth review introduced for the first time the results of some work that had been done in the field of poverty; the Council wants to continue to do work in this field. We have also undertaken a very wide variety of other kinds of research.

In our brief we gave you a list of the publications of the Council. The Council has used its authority to publish very freely and openly with a view to maximizing the availability of the work it does. Indeed, in the four years or so since we issued our first publication we have issued some kind of publication or other on the average of more than one a month; so it has been a fairly heavy program of output and I think a number of people in different places and in different disciplines have found some of these things useful.

Perhaps I have said enough, Mr. Chairman, to open the discussion.

The Chairman: Thank you very much, Dr. Smith.

I think that we should try this afternoon, as we only have about two hours, to try to concentrate the discussions on two major topics: First of all, the role, functions and responsibilities of the Economic Council; secondly, this chapter in the last annual review which deals also very directly with our inquiry, this chapter 3 on science, technology and the economy.

So that, if you agree with this, we should try to move first perhaps to the role and functions of the Council and then devote the remainder of the afternoon to this chapter on science, technology and the economy.

Do you agree with this, Senator Cameron?

Senator Cameron: Yes.

The Chairman: So you can start now.

Senator Cameron: Mr. Chairman, I think that the members of the Economic Council must feel in a very sympathetic climate here today, because I know people in Canada who have a great feeling of indebtedness to the Economic Council for the splendid contributions it has made to the economic thinking and to the decision making in the last few years.

To begin with, and this should not take very long Dr. Smith, you said that you feel that the Council has established its work very satisfactorily, but you also emphasized the role of change and the rate of change.

Do you feel that looking to the future there are changes required in your terms of reference which would help to make your work more effective and also enable you to get results that would be helpful to the decision makers more rapidly?

Now, this is no reflection on what you have done; I think you have done a fine job, but what I am just wondering, looking ahead a bit, do you see any areas that we should anticipate?

Dr. Smith: I must confess I have not thought about this very much; one of the things about national economic bodies is they have a tendency to evolve and change. This has been a general phenomenon in most countries and I presume that this Council could very well evolve and change in various ways in the future, too.

At this point, however, it is still very young; we are just past our fifth anniversary of the first meeting of the Council and especially since the Council operates very much in a public way, where there is an opportunity for people to assess what we are doing, to give us advice on what we are doing, I would think that at this point the Council is progressing reasonably satisfactorily.

One of the things we discussed at the last Council meeting was the possibility that the Council might meet rather informally some time later this year itself, perhaps with the former members of the Council as well as the present members, to review what the Council had done in the first five years, how effectively it has worked, and to consider the road ahead.

Senator Cameron: Trying into that, one of the things that we are interested in here is the relationship between the various bodies we have set up. Could you in a few words specify your relationship to the Science Council, the Science Secretariat and the National Research Council?

Dr. Smith: Yes. In terms of our relationship with the Science Council, there are a number of relationships here; I think Dr. Solandt mentioned some of these when he was before you.

The Chairman: Association by guilt.

Dr. Smith: The Chairman of the Economic Council has been an associate member of the Science Council since that body started. As such, I am an associate member, so there is a direct connection in membership.

We have consulted about various things; we kept in close touch with them, for example, on the work we were developing for the chapter in the Fifth Annual Review on Science and Technology and The Economy. We kept very closely in touch with their work on their Report No. 4, towards a national science policy for Canada.

I think Dr. Solandt even added that we have the highest of all forms of co-operation, namely, that we have raided each other's staff. Mr. Wilson has gone

from our staff to the Science Council and Mr. Henderson has come from the Science Council to our staff.

A close relationship between the two Councils is, I think, very important and in a number of ways it ought to develop further. We have talked informally about the possibility that the two Councils, for example, might sponsor one or two conferences in the future and I think there is a very good deal to be said for close connections of this sort between them.

With regard to the Science Secretariat, we have not had very close connections with the Secretariat as such. It is, of course, a body inside the government.

With regard to the National Research Council, again our contacts have not been very close, although we have had contacts with them on some things. For example, we are now at a stage where both the Science Council, as well as the Economic Council, have stressed the importance of strengthening industrial research and technology and the National Research Council is also very much interested in this field; we have had some contact with them on this subject.

There may be other opportunities here which we should develop too.

Senator Cameron: I left out any reference to the Social Science Research Council and in view of the fact that much of the change that needs to come about in Canada is in the realm of the social sciences and their application have you had any special relationship to that Council and do you see a new and increasingly important role in relation to their problems?

Dr. Smith: We have a connection at the moment in the sense that I am a member of the Social Science Research Council, at least for two years now, but this connection has not been close up to now. There may be opportunities here. The Social Science Research Council, however, is in the process of developing a new constitution with some changes in functions. That is not finally settle, I understand.

Senator Cameron: I think, Mr. Chairman, that the sequence of these two hearings, the one this morning with the Dominion Bureau of Statistics and the Economic Council, are rather fortunate. You were present this morning and heard the discussion; you have also emphasized in your brief the importance of more complete and more current statistics.

Have you any special recommendations to make to this Committee which would help to bring about more effective and timely statistical resources?

Dr. Smith: I was not present for all the discussion this morning, but I heard some of it and you are right; we went out of our way in a sense to point out the importance of statistics, of good information for analytical purposes.

The Council in the past in its reviews has called for a strengthening of the information base in this country, and in particular the statistical base, of the Dominion Bureau of Statistics. I think there are a number of ways in which quite clearly the statistical base should be strengthened and the Bureau as an institution should be strengthened.

One of the great difficulties, as the Dominion Statistician pointed out, is trying to get really good quality manpower. This is a major factor. At some times in the past I think inadequate access to financial resources has also been a problem for the Bureau. In any event, we are in a situation where in some important respects the quality of the existing information is not as high as it should be and this is all the more important at this stage when we are attempting to use more sophisticated techniques of analysis.

I think the quality of much of this information, while it has been improved, needs to be improved further.

We are also I think at a stage where we need to have now much more information in many new fields; there are a number of extremely important areas in which the existing information is much too limited. There are other areas in which we know at this point virtually nothing about some things; I can give you some illustrations if you like, but there are extremely important areas in which, for policy purposes, we need to know much more than we now know.

Senator Cameron: Is the impression wrong that more emphasis has been placed on gathering quantitative material surveys rather than an emphasis on the analysis of information we already have?

The Chairman: In the Bureau, do you mean, or in the Council?

Senator Cameron: In the Bureau; I am getting at the impression you leave here very definitely that we need more effective . . .

Dr. Smith: I would like to comment on both sides, if I may, Mr. Chairman.

Senator Cameron: Yes.

Dr. Smith: I think it is very important in the Bureau to strengthen the analytical capabilities, for two reasons. First of all, I think the analytical capabilities

need to be strengthened in order to produce better statistics. You need to know a good deal more about the statistics, you need to know more about how statistics are being used or can be used in order to develop the right kinds of statistics.

This function is very important as a background simply to the production of statistics of the right kind, of high quality.

There is another very important reason within the Bureau, too, and that is that people who work with the production of statistics I think have a natural inclination—it is inevitable in the circumstances that they would like to also move to at least a preliminary stage of assessing the results—of asking what do they mean, how do they fit together?

That function can be performed at the Bureau in many fields in a very useful way by people who are close to the statistics, who know some of the deficiencies, who are very familiar with the concepts involved.

Outside of the Bureau I think too we are at a stage where the analytical use made of available information can be very greatly advanced. We have not in this country made as much effective analytical use of the information at our disposal as we could have.

Mind you, in many ways, we have attempted to do this. Unlike the natural sciences, we have had a good deal of mission oriented activity in the social sciences, particularly in the form of royal commissions and task forces. In the field of applied research, if I may call it that, some very good work has been done. But on the whole this has been done rather inefficiently in large "surges" and then all the work is put away; it is not continued.

So there has been, and remains, a great deal of scope to strengthen the analytical work outside.

I had intended in my opening remarks—and you may want to come back to this, in the second part of the discussion—to read a few sentences about the social sciences from the Council's review as well. We are touching on that field now.

Senator Yuzyk: What liaison does the Economic Council keep with the DBS? Is there some permanent link through which the Economic Council can convey its demands or needs so that DBS would be in a position to better serve you?

Dr. Smith: Yes; we have various arrangements. At the start of the Council's work we had an arrangement under which there were two or three people who, in effect, virtually held joint appointments between ourselves and the Bureau in connection with some of the work which we needed to have done, especially in the demographic area.

The information was at the Bureau; our analytical needs were best served by having some people who could serve as "bridges" between the Economic Council and the Bureau. This was one kind of link.

The second kind of link is that we agreed from the start that in all areas of our research we would operate in a way in which the members of our staff would take the initiative to be in touch with people at the Bureau in areas where they needed information, and work very closely with the specialists in the different areas of the Bureau. This has been proceeding in a very active way in all of the areas of our research.

Thirdly, coming more particularly to the question you were raising, about anticipating needs, we have an arrangement under which Mr. Goldberg and I meet periodically, perhaps twice a year or so, and discuss our future program, some of our future needs for information that the Bureau could provide for us. We tried to do this in a way which would provide the Bureau with the maximum amount of time to anticipate our needs. Within that framework we worked out various arrangements to have certain special things done to meet our needs at the Bureau, to accelerate certain revisions of data at the Bureau, and so forth.

Senator Yuzyk: Would you consider then that this cooperation is quite satisfactory?

Dr. Smith: This has been working very well. I might add that we also continue to have arrangements under which various people at the Bureau have assisted us in our work. Miss Podoluk is here today; she assisted us in connection with the poverty chapter. Mr. Zsigmond of the Bureau now is doing a second study for us on enrolment information in the Canadian educational system, including projections into the future and so forth.

Mr. D. McQueen, Director, Economic Council of Canada: Mr. Chairman and honourable senators, I would just like to add one other facet of our cooperation with the Bureau. You have already heard, I believe, from the representations of the Bank of Canada and the Dominion Bureau of Statistics about the set-up of certain information banks of economic statistics, Data Bank-Messenger System and the Canadian Socio-Economic Information Management System (CANSIM). The Economic Council has played an active role in both of those also, so that is another link with DBS.

The Chairman: I must say that Mr. McQueen was formerly working with the Bank of Canada; that is another link.

Senator Leonard: We were told this morning that you were responsible for the starting of this data bank.

Dr. Smith: Yes. We had a young man, Mr. McCracken who had a good deal of capacity and interest in this field, and he took the initiative to start things developing. With the aid and cooperation of the Bank of Canada and the National Energy Board, we constructed a data bank and made it operational. It became apparent that this was going to become limited and increasingly inefficient as its size grew; it tended to grow quite rapidly. At that point Mr. McCracken, who had helped us with the first part, had to return to the United States and we took on our staff Dr. T. J. Vander Noot who spoke to you this morning. He worked almost full time with the Dominion Bureau of Statistics in constructing a much larger data bank, which is now nearing completion. Now he has moved to the Bureau and will be there to help operate it.

The Chairman: I would like perhaps to ask a question referring to the Act: The Act says in Section 9, I think it is, where the terms of reference are defined, that one of the first duties of the Council is regularly to assess, on a systematic and comprehensive basis, the medium and long term prospects of the economy, and to compare such prospects with the potentialities of growth of the economy.

I noticed a moment ago when you were referring to this part of your responsibilities that you mentioned only the medium term and it seemed to me that the Council, with two exceptions back in 1963 in the first annual review and then in the fourth annual review, has done very little in this most important sector of its assignment, namely in the field of assessing long term prospects and comparing these prospects with the long term potentialities of the economy.

Is this mild criticism true or justified?

Dr. Smith: I suppose a lot depends here on how one defines the word prospects. What the Council has done is to take a look forward over a period it thought it could cope with.

The Chairman: But this has happened only twice in the five years and more or less for the same period.

Dr. Smith: Yes. We did it first for the period 1963 to 1970, but we came back to do this in the Fourth Annual Review. As I indicated earlier, the Council felt that there would be diminishing returns from putting a lot of resources into doing this every year, rolling forward its medium-term assessment by one year each time. We thought that by the Fourth Review we should do it again. At that point we undertook a new look forward, this time, a three-tiered look. The rationale for this was that we tried to take each of the parts forward over a period in which we felt that we could get useful results. We

took the population, the labour force, the basic demographic projections forward to 1980.

We did a new estimate of the potential output in the economy to 1975. In other words, we looked at the supply capabilities, at the manpower resources we would have available, the capital resources available, at the productivity rates which we thought were reasonable, to 1975. So, we moved our assessment of the potential of the Canadian economy forward from 1970 to 1975. Then, on the third tier, we took a look at demand possibilities in the economy to 1970.

We had wanted to take it further; we wanted to go up to 1975 also. However, there were several reasons why we felt we could not do this for the Fourth Review in a meaningful way.

First of all, there were virtually no studies then available, or plans available on the international side that would give us a good view of the possible developments in the international economy to the mid-seventies. For Canada this is a very important matter; it is one of the fundamental things that one has to take into account in assessing the possibilities here. We knew that a variety of plans were in process and would be becoming available within a year or two; they were not available then.

Secondly, the work on the tax structure committee had been available to us on the government side for the earlier work, but we did not have a very good view on the developments in the government sector beyond 1970; indeed, the government sector was in the process then of very rapid change, and it still is.

But thirdly and perhaps most important of all, we knew that a major revision of the national accounts was under way at DBS and the demand analysis—for example, on consumption, investment, and international trade—depends very heavily on the national accounts data. So we decided, pending the development of that revision, to carry the demand analysis only to 1970 again, and probably come back fairly quickly, as soon as we could, to carrying the demand analysis forward to the mid-1970s.

We are now engaged in that work and it is the intention of the Council that its Sixth Annual Review, to appear next September, would set out demand analysis together with another look at the potential output analysis to 1975.

This concerns also the question, if you like, of prospects and performance. Having set out, if you like, the medium-term possibilities in the economy, each review contains a chapter which really asks the question: How was the economy progressing in relation to the medium-term possibilities in the economy? Are we falling short in some way, in a persistent way, in a major way, from good progress towards these goals and objectives, or are we on the

whole doing fairly well? Are we improving our performance?

So with each review there has been that kind of performance assessment.

The Chairman: But do you consider that looking further than 1975 is more or less a useless exercise, or do you consider that this is the longest period that you can usefully consider?

Dr. Smith: I would hope perhaps at some stage that we may take a longer look forward. I think there are some useful things that can emerge from a longer look, but we decided to concentrate on what we agreed to call the medium term, in the 5 to 7 year range, because a great deal of the decision making that takes place—even what is often called long-term decision making in government or in business—does not extend to a horizon beyond that. Indeed, much of it is within a horizon of two to three years, and a great deal of it in the next six months.

The Chairman: Perhaps this is exactly what is wrong.

Dr. Smith: One of the things that I think has emerged increasingly clearly from our work is the view that it is extremely important to develop a better understanding of medium-term 'possibilities,' because many of the decisions of today really only produce their effects after a very considerable lag.

The Chairman: Perhaps 20 years from now.

Dr. Smith: In some areas, yes.

Senator Cameron: Mr. Chairman, I was just going to underline that the consensus of all the scientific recommendations we have had so far is that the results from scientific experimentation and innovation will only come into being about 10 to 15 years afterwards. In view of the need to make a decision now that will be bearing fruit 15 years from now, would you not think it is imperative that we spend some time analyzing as far as we can the projections of what is likely to happen in the development of certain scientific processes?

To use the illustration of the ING project which was cancelled, the long range implications are very serious. There are many others, that is just an illustration, but does it not suggest that if there is a 15 year lag between the conceptual program and its transition into practical economics that we should spend some time, or put a task force on this and on a number of basic scientific problems?

Dr. Smith: Yes, I think this is a useful thing to do. We need to know a lot more about how to do it well.

We did have, of course, something that was much more akin to a long term view in the Royal Commission on Canada's Economic Prospects in the mid-fifties. That took a view to 1980.

The Chairman: It was 25 years.

Dr. Smith: Of course you know all about this, Mr. Chairman. What happened with this one, and it may have had some influence on the emphasis on the medium term, is that its long term views, I think, still look very good, but it did not provide very much help on the medium-term because the way things evolved and developed in the economy in the late fifties and early sixties was quite different from the long term trend that was anticipated.

From that point of view it was not a very useful background really for many decisions of the time. Yet more recently the concept of taking a longer view is becoming much more important and is being given increasing attention.

The Chairman: And fashionable.

Dr. Smith: And fashionable. But our tools are not very good. The French, as you may know, in connection with their fifth plan did a little study which they published looking to 1985, but they were not altogether satisfied with it. They are, I believe, now attempting a much larger and a much more ambitious project, but it is one that will take a lot of the resources. Our tools and techniques for looking in the social and economic area that far forward are still very crude indeed; our information for this is not very good.

The Chairman: But meanwhile it seems to me that a lot of countries, for instance in the United States and in Great Britain and, as you mentioned, in France, not only this 1985 exercise, but others, and in Germany, even in Austria, more and more these countries seem to try to look at the long term also and even towards the year 2000.

It seems to me that this would be, of courses provided that you have a proper determination of your priorities, this would seem to me to be a very important function of the Council.

It is, of course, definitely included in its terms of reference and there does not seem to be any other agency around in Canada at the moment at least which is looking at that long term future.

As I can see this situation evolving at the moment there is more and more a consensus, I do not say about detailed forecasts, but there is more and more a consensus of what is going to happen. There is more and more a consensus of what is going to happen all over the world and here it seems to me that in Canada we have this gap and perhaps you do

not have the time or you do not have the interest, and if you do not perhaps other agencies should become interested in this field, but it seems to me that it would be most useful for Canada to have this kind of exercise provided, of course, we do not attach great importance and we do not treat these long term forecasts as encyclicals or as visions, but it seems to me that it would be an important function of the Economic Council to develop.

Mr. Fred Belaire, Secretary, Economic Council of Canada: We have under active consideration with the Science Council the possibility of a jointly sponsored conference in this area. I think it is important not to look on such forecasting as an economic exercise; it is sort of half way between the hard sciences and the social sciences.

The Chairman: Do not try to duplicate what we are trying to do, though.

Mr. Belaire: No, but it is important for the economist to have some knowledge of the technological environment in which the policies he is recommending are likely to be operating and, of course, the hard science input is really on the hardware side, because the natural scientists are in a better position to make an assessment about this. So it should be a matter of mutual interest for both Councils.

Mr. McQueen: Mr. Chairman, could I add this one short bibliographical note here. I think a very excellent article on some of the peculiar problems of this longer term economic forecasting is to be found in the last issue of *Encounter Magazine*, by Andrew Shonfield. It is called "Thinking about the Future" I think he brings it out very graphically, how the kind of projection techniques which economists use for five or even ten year periods start to fall apart when you go on to twenty-five or thirty years, when the whole nature of your gross national product may be changed.

I would certainly commend this article to anybody who is interested in longer term forecasting.

Dr. Smith: May I add a footnote to that, Mr. Chairman: There is a very perceptive little comment in that article which I found very well put. He said that when the social scientists and the natural scientists get together to talk about the future they usually approach each other in what he called a sort of mock accusatory tone—each accuses the other really of being in the decisive position. The social scientists say to the natural scientists:

"Now, you tell us where technology is going to take us over the next twenty-five years or so, then we can set to work and discuss the kinds of changes this is going to bring about in society and how we can best deal with these."

The natural scientists say, if I remember the words:

"Well, never you mind about that; now you just give us our marching orders. You tell us where society is going over the next quarter of a century. Nowadays we can do almost everything that we set out to do with the technology and knowledge at our control. Tell us what our society's goals are for the future, what are the real needs, and we will make sure that technology helps to provide for these needs."

In the subsequent interesting discussion, the author comes down on the side of saying—I thought this was very interesting—that in fact a great deal more perception about the future is likely to come from the social and economic insights than from the technological ones in the future, and that we need to give this a great deal more thought.

But we do not know how to do this very well yet; we still have a lot to learn about how we do these things and I suppose that in the last analysis what really comes out clearly in this, is that the one thing that is missing is any clearly articulated set of goals for society, goals that command a consensus of our people; goals that are considered to be both important and in a basic sense right for our country.

If you can get that into position—and governments have an important role to play in getting us into that position properly—then the development of the future in an appropriate way to achieve goals can, I think, be helped a great deal by both the social scientists and the natural scientists working together.

The Chairman: Yet you just told us that the work which had been done in 1955 to 1956 by the Gordon Commission on Economic Prospects for 1980 still was very useful as a guide-line.

Dr. Smith: Yes, on the whole.

The Chairman: Do not tell me that our methods of forecasting have worsened since 1955.

Dr. Smith: No; perhaps just in the sense that the overall estimates are pretty good. It is when you get down to the sectors and the details that you find that things are not all fulfilled. This, of course, happens with all planning; the aggregates turn out to be better, but the details do not quite develop in the way they were anticipated.

The Chairman: Still I maintain that it would be useful to have the aggregates.

Senator Grosart: Mr. Chairman, we have talked about just about all the sciences in the realm of forecasting except the political sciences. It seems to me that I have heard a good deal of day dreaming here about the possible validity of economic and

sociological forecasting, and I am wondering if it takes into account the unpredictables of political forecasting. If one looks at the record of the five-year plans, the end look of the five years does not give much validity to any five-year plan that I have looked at.

Mr. Smith was talking about the possibility of the social scientist predicting where society is going. Could anybody possibly have predicted the Black Power movement? There was no possible predictability of its present magnitude, or what has happened in our universities—the sudden explosion.

Certainly there was no social forecasting of this. It may have been said, "If we do not do something about this, something is going to happen", but there was nothing even close to precision in this area.

Unless we can improve somehow in the economic area our systematizing of information, surely we are day dreaming when we talk about the benefits we can get from forecasts of 1980.

We were told, for example, this morning in the most positive terms by DBS that there is absolutely no coordination of information as between DBS; I say no systematic . . .

The Chairman: Collection of data.

Senator Grosart: Yes.

The Chairman: Really more than information.

Senator Grosart: Yes; collection of data between the Economic Council, DBS, the Department of Finance, the Department of Trade and Commerce and all the rest, that at the moment we have not any system for the control and the systemizing of this information.

Now, who is going to do it? We have been talking about long-term; we have been talking about mid-term. I am particularly interested in the short-term, because our terms of reference are to come up with a science policy for Canada. I repeat what I have said before, that in political science (and ours is a political reference, it is the short-term advice that is needed in science research, development, technology or innovation or whatever you want to call it.

As we know from the ING decision, the telescope decision and many others, the Science Council told us it is not their business to be concerned with the short-term advice. I gathered that it is not a major responsibility of the Economic Council.

Can you tell me in your opinion, sir, who should undertake this very, very important responsibility of giving advice tomorrow morning to the government as to what they should do in connection with the next major critical decision in science policy?

Dr. Smith: Mr. Chairman, Senator Grosart has raised a whole series of issues here. I have no intention of representing political science as such; but it is a part of the social sciences and should be an increasingly important part of the social sciences as well.

On the question of data, if I may go back to this, one of the things that I think is extremely important and that we need to realize in this country with regard to the Dominion Bureau of Statistics, is that it is primarily an agency for collecting and handling social science information, and social information of certain kinds and perhaps a few other things. In this country with that institution as a centralized statistical agency we are very fortunate, in my judgment, as compared with the United States, where there is a great deal more decentralization of information. Having a central statistical agency with the possibilities here for increased consistency of information, increased efficiency in producing information, avoidance of the development of conflicting information collected by different sources, this is very important.

From our standpoint at the Economic Council we took the position right from the start that when it came to the development of statistical information required for our analysis we would essentially rely on the Bureau and turn to the Bureau for our needs. In a few very specialized areas where the amount of information we needed was of a qualitative character as well as of a quantitative character, we have undertaken to gather information through interviews with businessmen—for example, on two or three projects we have undertaken—but basically we turn to the Bureau for this and I think this is the proper way for us to proceed.

Senator Grosart: Except, Mr. Smith, if I may interrupt, the Bureau told us this morning that response to referrals was a very, very minimal part of their work.

Dr. Smith: The government departments responsible for economic research by and large certainly do, and the little I know about private social science research, many experts also in fact turn to the Bureau for much of the information they use. On the analysis of economic developments, certainly the Bureau produces the basic data that are most widely used.

The Chairman: I think Mr. Duffett this morning was referring more particularly to the growing confusion and to duplication in the specific field of gathering data about our scientific effort than anything else.

Senator Grosart: I did not gather that he limited it to that.

The Chairman: Oh, yes; that point was made in one of their two annexes and it was a comment

regarding this specific column I think that he was making.

Senator Grosart: That is all right with me, Mr. Chairman, because that is the area we are dealing with in this connection.

Dr. Smith: One of our concerns at the Council about the importance of strengthening the Bureau has in fact been to provide it with the capacity to meet growing needs for information by government departments, by provincial governments, by other analysts in the universities and elsewhere, so that we would minimize the danger that in increasing demands for information we would move in the direction of getting a growing decentralization of information collection that might prove to be inconsistent in many ways. This is why I think there is a great virtue in strengthening the Bureau adequately to supply the growing range of information that is in fact required.

May I come now to the question you particularly put, about the short term. I cannot really pretend to speak at all about projects like the ING project, or the telescope project, or about other scientific projects which may come up for assessment, but certainly on the economic and social side there is a very considerable amount of attention within government departments to looking at problems and at various developments as a basis for day to day advice.

It was, in fact, partly because there was so much concentration of attention on the short term that the Economic Council was created as an institution to do something that was not being done—that is to focus attention on the medium and longer term. There was quite a lot of work being done on the short term outlook, on current trends, but very little being done in the medium-term, the medium and longer term. The Council was set up as an institution to move into a vacuum in this area.

The Chairman: But do you not think that in this one field of economic research in relation to Senator Grosart's question that even in this short term sector there are still very important gaps, because if I remember well the Council has proposed that there should be a kind of special research institute in dealing with the economic business cycles and dealing also with the short term outlook as opposed to the medium term outlook, so I am sure that at that time the Council had it in mind that there was a very important gap within the government research effort in that field?

Dr. Smith: It was not I think so much with respect to a gap which existed in government in that field; it was with respect to a gap which existed in public information and analysis as a basis for creating a

wider public understanding about what was happening in the short run.

The Chairman: Do you mean that the hidden reports were good but that they were not made available to the public?

Dr. Smith: I am not judging quality now. But you see there was a good deal of work that was being done in government departments on the short term and in agencies such as the Bank of Canada and there is a good deal of short term work being done again in the economics area within many private firms and institutions. Some of the business firms have economists to look at this and they are advised regularly. But there is not a public institution in Canada that provides information that is generally available and that can serve private firms and institutions in an open way as a basis for discussion and debate about what forces are working on the economy, what trends are evolving, what the short term outlook is and what factors are playing on the development. This kind of an institution exists in a number of countries and is playing a very useful role in a number of countries.

The Chairman: You are referring, for instance, to Dr. Tinbergen's work, I suppose it is part of the activities of this agency in the Netherlands?

Dr. Smith: In the Netherlands Professor Tinbergen was the first director of the Central Planning Bureau for its first ten years, from 1946 to 1956. Even in the early days it was part of the Ministry of Economic Affairs. So it was in effect a government agency, but like the Economic Council it produced a publication.

Unlike us, it focused for quite a long period of time on a year to 18 months ahead; it was dealing closer to the short term end of the spectrum, and only more recently has their work extended to do four and five year planning.

I am thinking of institutions like the National Institute for Economic and Social Research in the United Kingdom, or the Japan Economic Research Centre. Sweden has a Business Cycle Research Institute. In the United States there are quite a number of institutions that do this research. In Canada we do not have one.

Senator Grosart: Except that in some of the provinces we have economic councils which seem to be pretty close to the day-to-day realities of decision-making.

Dr. Smith: Not really, Senator; not in the way they are operating now.

The Chairman: I think that Mr. Smith is not dealing really with the day to day advice on economic policy to the government, but to some kind of research exercise on the short run which would be available to the public, which is a little bit different.

Senator Grosart: My question is again in the science area and is related to the assessment and analysis of advice, the input, to use the old phrase, the input of science into science policy. It is in this area that all the evidences we have had so far, as I assess it, indicates that there is a tremendous gap.

An obvious example is grants to universities: Many departments are giving grants; crown agencies are giving grants in science and the research and development field to universities. We have asked departments: "When you make up your list this year and put it in your estimates, grants to ABC universities for XYZ projects, do you know what your next door neighbour is putting into that same basket?" The answer has always been: "No; we do not know. We make up our own estimates."

Perhaps this is a question we should ask the Treasury Board when they are before us, but I would be interested to know if anybody knows if at this moment, for example, there is a list which says: "Here are all the grants being given to universities for R and D from public funds. Here is an analysis of the projects and here is some kind of systemizing of them."

I do not believe such a thing exists; I am directing this query to the work of the Economic Council.

The Chairman: But you are dealing more or less directly with the chapter of science and technology; I thought we were still, at least up until 5 o'clock, on the Economic Council and its responsibilities.

Senator Grosart: That is exactly the point I am on; I am just trying to find out if the Economic Council thinks it has any responsibility in this area, to advise, to recommend, to initiate.

The Chairman: On science policy with respect to the physical and the live sciences?

Senator Grosart: Yes; we must assume, in spite of some differences of opinion, that somewhere or other R and D has a function in national productivity. We may not be able to measure the function, as you said today, Mr. Smith, and as you say in your report, maybe we should be looking more at the innovation stage but, of course, the innovation stage does not come unless you have the prior stages. That is my point.

Dr. Smith: May I read you very briefly a short piece out of the 4th annual review of the Council,

which indicates that we are very much concerned about this question of better coordination of the kind you are talking about.

We put it this way:

Within individual departments and agencies of any individual government there are inevitably preoccupations with problems, policies and programs in the areas of their own special responsibilities. Moreover, governments tend to become preoccupied with one area of problems and policies at one time, and another area of problems and policies at another time, so that even broadly related questions may frequently be dealt with in a rather isolated sequence. The effective machinery seldom exists to consider in a continuing and consistent way the interrelations between problems, developments and policies over the whole range of affairs with which government is concerned.

It is even broader than the science coordination question; it extends more generally.

We go on to indicate that in a country like Canada, with our kind of decentralization, if we are going to get good performance, we not only have these problems that typically exist within governments, and for which we do not have now in many areas good coordinating machinery, but we also have larger problems than in most countries because the operations and activities of other governments must be coordinated in some kind of way.

Beyond that we have a kind of system, very much a mixed system, in which the private sector of the economy is extremely important in terms of the decisions required for achieving good future performance. Most of those decisions are going to be made in the private sector and not by governments at all.

So the Council is saying we need to think much more carefully than we have up to now about how to achieve better coordination within governments and better coordination between governments and the private sector.

The Economic Council is very much concerned with this and has been centrally concerned with this because it is not a body exclusively concerned with federal matters. We are not in business just to produce information, advice and analysis for the federal government. We are not in business just to be concerned with the federal area. We are set up as a body to be concerned with national goals, national problems and national policies. How do we make all the pieces work together well? We have got to make them all work together well if we are going to have high standards of performance.

Senator Grosart: The situation that I am directing my question to is perhaps this, that at the moment

it happens to be the fashion for everybody concerned to take part of the credit for the transferring of some percentage of government funding from inhouse into universities and into the industrial sector. Almost every report, including your own, draws attention to this. It says this is a fine thing, it is a good thing that is going on and we have had a part of it. Yet the fact remains that I have not seen anything that I would call a science policy analysis of the situation which tells me why this is the right thing to do.

As far as I can find out, these decisions that there was an unbalance come from an OECD report which said that Canada is different from everybody else and that we must do something about it. We had got more inhouse R and D than anybody else, therefore it was concluded that we must be wrong.

The second point in that connection, of course, is that if it was wrong, if there was an imbalance, how did it happen? Obviously because of thousands of science policy decisions that in aggregate were wrong.

The Chairman: I think that to follow up on this, even in your chapter on science, technology and the economy, at page 54 you say, for instances:

What is required is the development of a coherent strategy which coordinates and blends the scientific, technological and innovative capabilities of government, the scientific community, the business sector, and the universities.

What did you have in mind there? We certainly do not have at the moment this coherent strategy. How can we improve our system in order to have it?

Dr. Smith: I do not think there is any easy answer to that at all. Some new institution created in some way is not necessarily going to achieve this.

I think first of all there needs to be simply a clear recognition that we have been moving with a lot of bits and pieces at the moment and what we are really talking about here is how eventually we conceive of putting this together as something that really becomes a coherent science policy.

At this stage I do not think any country has a coherent science policy. I am not sure but that there may be some that do not want a science policy; they may not want it in a way that may lead to too much direction and control which may evolve if you were to move very far in the direction of a centralized system. But at this stage we are really trying to feel our way, I think, to some kind of means of making a start in this direction.

I might say with regard to our emphasis on the importance of strengthening industrial research and technology, we have a special committee of the

Council, an advisory committee, which worked in the field. I think that what emerged clearly in the councils' view is that, given the importance of the whole innovative process, performing a larger segment of the R and D activity closer to where the whole innovative process takes place makes a good deal of sense.

As I understand it, the National Research Council was designed as a body which should quite easily develop various things which could fit into the industrial field, but it did not work very well in this direction, perhaps for a number of reasons.

The Council's Advisory Committee on Industrial Research and Technology came to the conclusion that on balance it would be better to think about means for strengthening industrial research and technology in industry.

Mr. Andrew H. Wilson (Former Secretary and Chief Research Officer of the Advisory Committee of the Economic Council on Industrial Research and Technology, and now a member of the staff of the Science Council of Canada): Mr. Chairman, senators, if I might just comment for a moment, Dr. Smith is quite correct in the conclusions which this committee reached and I have since backed this up by findings in industry itself. I find that there is a very strong realization amongst industrial people that regardless of whether there may be competence elsewhere in Canada it must be resident in their company or in their division of their company if they are to compete in the marketplace. I think in fact there has been a whole new ball game in R and D in industry which has grown up since 1960. This has been fostered in a way by the economic climate; it has been fostered in a way by the kinds of programs which the federal government has had and has been fostered by a whole change of attitude in management.

Of course, we have got a long way to go, but nevertheless there is this direction towards achieving greater technical competence. In fact, in some companies it goes further than this; they say "well, we are going to increase our ability to trade information, that information is in fact a good which you can trade in the marketplace, and we are going to re-design our R and D program and we are going to acquire competence which is exchangeable. By so doing we can build on other people's strengths where we need it and we can build on our own strengths where this seems to be appropriate."

Senator Bourget: Mr. Smith, in assessing the prospects of the economy in different regions do you rely mostly or entirely on the statistics given to you by DBS, or statistics given by the provincial government or some other organization, or do you have some of your personnel who will go on the site and

make a study so as to make a kind of verification of the statistics that are given to you and that would help you eventually to make a recommendation for development to improve or promote the industry?

Dr. Smith: Senator, we have relied for the basic framework of our statistics on the information provided by the Dominion Bureau of Statistics, again because of the value of having a consistent set of statistics that also ties in with others in a developing framework of analysis. But we have been in touch with people in the provincial areas, with people in the provincial governments. In some areas there has been information that has been provided to supplement this; in some areas we have also needed new information.

Let me cite the illustration here of the educational area, which is an area of provincial responsibility. Our statistics on certain very fundamental aspects of education were very poor, we found. We found when we first came to deal with education that there were not regular consistent figures drawn together by anyone on enrolment, by years of school, by ages, by province, for the country; they did not exist. We therefore took on Mr. Zsigmond of the Dominion Bureau of Statistics; we wrote on his behalf to various provincial ministers and departments of education. He went to see them, collected information and put together the statistics in this field for the past. On the basis of this he made some projections of enrolment for the future. This is one illustration of the way in which we proceed.

We have not done very extensive regional analyses within the various regions, but we have used a number of outside consultants on regional subjects. For example, we have at the moment a major regional study in the field of agriculture being done at the University of Manitoba. It is attempting to get at the question of the advantages of growing different kinds of crops in different regions of the country. There are some studies of this kind that we have done.

Senator Bourget: Do you intend to get some more qualified persons who will be able to make that kind of study so that it will be easier for you to make some useful recommendations so as to fulfil your additional duties that you have under article 11?

Dr. Smith: This concerns a series of things relating to labour management relations, productivity improvement and other things.

Our regional analysis really comes under section 9 in the Act. I might say in this field we are in the process of continuing to strengthen and develop our work in the regional field. This is a very important area.

I neglected to mention that there is one other very important set of studies which we did have done by people in different regions of the country. This was an attempt to review some of the policies used by various provincial governments that affect economic growth and development in the provinces. This is a study which the Private Planning Association of Canada has undertaken on our behalf; they in turn have found competent people in different parts of the country to look at the experience with these provincial policies.

The Chairman: You have been more or less for the past 5 years a kind of outsider looking in in so far as economic research within the government is concerned. Of course, you have done a lot of economic research yourself, but you have been also in the position of looking at the whole government operation from that point of view in particular.

We were told the other day by the Governor of the Bank of Canada that there was at the moment within the government no coordination of the effort made by the government in the field of economic research.

Would it be your view, too, and at that time if I remember well Mr. Rasminsky told us that he was not too much afraid of undesirable duplications in so far as this effort is concerned, but was much more afraid of gaps in important fields which were not attracting any kind of attention by any government agency at the moment.

Would you care to comment on this?

Dr. Smith: I do not know if I can say a great deal. What we have done in our program of work is that in any field in which we are working the staff people at the Council attempt to get in touch with people who have knowledge or who may be doing work in this field anywhere, within government, or at the universities, or elsewhere. In that way we have kept in touch with some of the things that have been developing in government, but we have made no attempt to make any overall assessment of the research that is being done in government or whether it is being coordinated.

I know of no system of coordination that now exists and I think I would agree with the Governor in this sense, that at this stage, the amount of economic research being done within government is really not on the whole very large. You heard the figures this morning about the magnitude of social science research within government; it was quite a small figure as you will realize in relation to the resources being spent on the natural sciences within the government agencies.

I think here I would agree that the greater problem at the moment is with gaps, that we are not looking

at some things we should be looking at, although obviously proper attention to preventing unnecessary duplication should always be a matter of concern.

Senator Grosart: Dr. Smith, you emphasized in your brief that the cost-benefit ratio of improved statistical information and research would be very high. Do you mean that, at the present time, there is insufficient funding of statistical information research in Canada?

Dr. Smith: I think the strengthening of the financial resources is one important element, but it is not the only one. There is a need, as I indicated earlier, for strengthening the information base in many areas, to add new work to cover very important problem areas. We have had a very intense, continuing shortage of high level manpower in the social sciences and this has probably been the most serious bottleneck problem of all.

In Canada we have simply had an underdeveloped state in the social sciences for quite a long time, one that stretches all the way back into the educational system.

Now, in the 60's we are beginning to make some progress, but prior to the 60's we had virtually no support of any significance—financial support I am talking about,—for the social sciences in Canada. We had made a great effort in the natural sciences to build up quite a lot of resources and this had the effect, I think, of stretching all the way back into the educational system and strengthening it. In the social sciences without this—at least as one element in the picture—the weaknesses stretched all the way back into the educational system.

As recently as 1962 or 1963 we were producing in Canada something in the order of 7 or 8 Ph.D's in the social sciences in Canadian universities, apart from psychologists. The latter was one area where there was research support of some size starting well before 1960.

The Chairman: Coming from the Defence Research Board and the National Research Council.

Dr. Smith: That is right, but in the social sciences we had virtually nothing, and by even as late as 1963-64 we were probably producing something in the order of 20 Ph.D's in Canada per year in all the social sciences together. As of 1967 or 68 we may be up to about 50 now, but that compares with Ph.D's in the natural sciences of five or six hundred or more at this stage and these are escalating very rapidly.

Senator Grosart: But you do seem to suggest a causal relationship between cost and improvement.

Dr. Smith: What I had in mind is that improved information in this area, where we have put very little effort in the past, is likely to add to our knowledge in ways which will allow us to achieve very large social returns in our economic system.

If we could find out how to run our economy—as the Governor of the Bank implied in his testimony—if we found out how to run our economy at one per cent higher employment level, one per cent lower unemployment, without having more serious price consequences, the kinds of economic returns we would get from that kind of improvement in our economic system would be very high indeed. Also, the people who would benefit most in that situation are the poor, the disadvantaged. This makes this kind of advance all the more important.

Senator Grosart: What needs to be done in the field of science policy to do the very thing you and the Governor of the Bank are suggesting?

Dr. Smith: Since I think that we are now well into the area of social sciences, may I read you a few sentences from the chapter on social sciences in our fifth review, page 52:

Social problems now constitute an increasing challenge to our society, . . . it has become unmistakably clear that our social and political mechanisms are not adjusting effectively to the rapidly changing conditions of life in the modern technological society. We are not developing adequate efforts and knowledge to cope satisfactorily with a broad range of social, political economic and cultural problems—for example, problems such as growing urbanization, pollution of our environment, housing, and the conditions of life in the big city. The results are reflected in institutional structures that resist or cannot adapt to change—in some tendencies towards the impoverishment of life and social maladjustment, including the creation of tensions and frustrations which contribute to the incidence of crime, violence, delinquency, mental disorder, and family breakdown.

The ways in which science and technology interact with the processes of social change are not well understood. Many of these processes require much deeper study by social scientists . . .

Yet the social sciences . . . remain relatively underdeveloped in Canada. The support given to research in the social sciences in Canada has been totally inadequate. It represents only a small fraction of the support for the natural sciences; it is smaller in relation to population and total income in Canada than in the United States and various other modern societies; and it is minuscule in relation to the social problems that now confront us.

We therefore recommend that there should be a substantial strengthening of social science research capabilities in Canada, including an enlargement and broadening of the support available for such research.

This is where the Council came down and said that one of the things that is very important is to extend our financial support for social science research. Now, this support through the Canada Council has recently been expanding very rapidly; it has grown, within the space of three years, about tenfold, from about a million dollars to I think about eleven million, or something of this order.

Thus, at long last, within the past two or three years, this has started to move up, and it is increasing rapidly. But it is still moving up from a very small base. Also, the dearth of high level professional manpower resources in this area is going to make it difficult to make social science research expand as rapidly as I think many of us would like to see, but we are now beginning to develop in the kind of way in which the universities are being strengthened, and one can look forward in due course over the next decade or two to a greatly increased flow of social scientists from Canadian universities.

Senator Laird: You mentioned that our efforts in this area seem to be considerably less than those in the United States and other countries, then in that paragraph you enumerate areas of concern, urban problems, pollution, etc.

It does not appear to me at first blush that the United States is very much ahead of us in trying to reach solutions for these problems.

Dr. Smith: In many areas they have done a great deal more work than we have, Senator. In various fields—certainly in fields in which we have undertaken work—the wealth and research analysis available in the United States is really something that is the subject of a good deal of envy.

When we started our work on poverty, for example, we found we had very little to build upon here by way of previous analysis.

Senator Laird: The Americans do not seem to be very successful in that area either.

Dr. Smith: In the last half a dozen years they have done quite a lot; they are beginning to find some interesting answers, some unexpected answers too, in many aspects of this field.

Senator Grosart: You go on, Dr. Smith, as I remember from that quotation, to speak of the necessity of coordination of the social sciences with the political sciences and the humanities and so on.

You do not think that pollution, for example, is only a concern of social science, or urbanization, or any of these other things. How can a science policy for Canada get these different scientists together on these problems?

Dr. Smith: That is a very good question; I wish I had a good answer for you on that.

First of all I suppose one might say that one of the things we are going to have to evolve is a way of encouraging people to work much more effectively in inter-disciplinary ways to achieve certain things. We have not really tried to do this in the past.

You see, if you take something like transportation in this country, which has been one of the most important things in our whole history from the time the country first started to develop, not until just now, just within the last few years, have we even had a transportation research institute at any university in Canada. We have operated all this time with transportation problems that have been recurrent and difficult and we have had no transportation research institute.

Now we are starting. Indeed, all of a sudden, there is quite a bit of interest in this. Now, if this kind of institute is going to develop effectively, there is a need for natural scientists and social scientists to work together on problems within a common framework.

We have up to this time, as of now, no institute of urban problems; we have no institute of human resource problems in Canada. Only two years ago or three years ago did we get an institute on government in Canada. In field after field in which we are looking at major problems, you will find we are underdeveloped and in need of encouraging the point you raised—people to work together in an inter-disciplinary way. But I think that this is not going to come overnight; it is going to require now initiatives, new organizations, and the development of new insight into the kinds of research that we really need.

Senator Grosart: To me the mystery of this is, as I mentioned on an earlier occasion, the transportation field. I recall taking a course in transportation, a political science course in the University of Toronto in 1924 and 1925 with Professor Jackman. What happened to it?

Dr. Smith: That was the seedling that should have grown into a tree and somehow it did not.

Senator Grosart: The University of Toronto did not live up to its motto *Arbor aeo* in that.

Dr. Smith: We had a lot of troubles in this country that inhibited strong growth of our educational

system in the 1920's and 1930's. We did not move to put adequate resources into our universities to make them grow. Also, we ran into the problems of the 1930's when our economy performed poorly and we did not have adequate resources to do many things that we should have been doing then.

Senator Cameron: I do not like to switch off the topic that Senator Grosart asked about because I am sure it is in this area that we must place more emphasis. However, there is a question that has been bugging me for some time; it is a very political issue and I am not asking it in a political sense but, as you know, one of the great political questions of our time is the relations between French Canada and the rest of Canada.

I have a feeling that if the Economic Council or some body at their direction was to make an economic analysis of the implications of what would happen if the worst came to happen, if there was a separation of Quebec from the rest of Canada.

What would the economic implications be? Now, I think there have been one or two rather miniscule studies; I may be doing an injustice in this, but it seems to me that part of your function under section 9 of the Act, and I do not need to remind you of your functions at all, but it seems to me that a study of the long range implications for all of Canada on what would happen if this happened, if say Quebec did separate or if a separate state was set up, even with some relationship, is important.

Now, as I say, it is one of the big political issues of our time and we will hear more about that next week but I have the feeling that the kind of analysis that you could do would enable people to act much more rationally in making up their minds about it.

Let me ask the question this way: Has any request of this kind been made to the Economic Council of Canada from any source?

Dr. Smith: No, no request has been made to the Economic Council from any source.

There has been a casual suggestion once or twice when I have talked with people in different parts of the country that perhaps this is something that the Council should do. But I think there might be some concern that if a body like the Economic Council were to attempt to undertake a study of that kind, it might be misinterpreted.

Senator Cameron: I realize that.

The Chairman: I think that your initial assumptions and hypotheses would have to be quite long.

Dr. Smith: I was going to add this, that if any such study were to be done it would be an extremely difficult one to do because, as you point out rightly, Mr. Chairman, the kinds of assumptions we would have to make about what kind of arrangement there would be, how it would come about, would be crucial and therefore trying to look at some particular kind of arrangement would be only one among a great many.

I am not sure how useful this sort of study might be.

Senator Cameron: I just wondered, because there is a lot of loose talk going around and it seemed to me that an economic analysis of Quebec's position today vis-a-vis the rest of Canada and Quebec's position on the basis of certain assumptions might be very useful.

I realize it would be difficult and I hesitated to raise it, but I think it is the kind of problem that we should take a look at and if there are compelling reasons why it should not be done, then I would accept it, but I would like to know those reasons from objective sources, if you can get such things.

Dr. Smith: From an economic point of view the loss of national unity in any serious way, even if it were not to involve separation of some part of Canada, would I think have quite significant adverse economic effects on all of Canada.

The Chairman: But then from that point of view we might as well study the impact of opposing the language bill in Alberta, for instance.

Senator Grosart: Or Biafra.

The Chairman: On national unity.

Senator Cameron: I think, Mr. Chairman, we have got to do something with our western premiers.

Senator McGrand: Regarding this meeting of minds between scientists, including social scientists, has this taken place in the older countries of the world, such as Holland and Scandinavia? They seem to have reached a level where they understand their problems.

Could you just speak a moment on what they have done that has achieved this?

Dr. Smith: A part of this is I think simply that far away fields look a little greener. My visits to some of these countries have generally produced a long catalogue of problems they have. I think I am most struck by the fact that we tend these days in terms of economic growth to look very enviously at the kind of growth performance Japan has, but when

you go to Japan and talk to people and see some of their problems, they have many problems to deal with too.

I think there are some things that have developed perhaps in a rather more favourable way in the two areas you mentioned.

In the Netherlands there has been a fairly explicit effort in that country to bring the social sciences within the framework of a science policy, or an approach to science policy. They have also developed along various other lines very successfully.

As you may know, the Netherlands has been one of the leading countries in the world in generating econometric analysis. This is very largely attributable to the fact that an extraordinary person such as Professor Tinbergen, who has started many areas of important work in the social science field, played a leading role in developing such analysis; and he managed to get good resources for this work. He is something of an entrepreneur, and he built a very good school at Rotterdam, and acquired in this field a strong international reputation.

The Chairman: The Soviet Union has done a lot to integrate and foster inter-disciplinary work.

Dr. Smith: Yes. In Scandinavia, too—in a country like Sweden—you have very outstanding economists by world standards, not just in the last few years, but stretching back into the 30's and the 20's.

This has been a lively, dynamic environment that has produced very good people.

They have also developed a very considerable capacity for doing good research, not just in the universities, but in business organizations, in the labour unions, in private institutions and in government. Also, the experts and the decision makers have developed a considerable respect for each other; they work well together, and I think in many ways they really are much further advanced—certainly in the field of economic analysis—in the practical application of knowledge to government and business policies than is the case in Canada.

The Chairman: In spite of losing good people to political parties and to international agencies.

Dr. Smith: Yes.

Senator Grosart: My question refers to the statement on page 49, which is in the sector of this report dealing specifically with science, technology and the economy. It is the second paragraph:

There is reason to believe that in other sectors, too, the amount of R and D would fall well short of a socially desirable level if left to private initiatives.

I gather that this is an observation that has a fairly universal application around the world. Is Canada at the moment falling behind other countries in this area?

Dr. Smith: In terms of government support of science?

Senator Grosart: Yes; first of all, government support and then, of course, the corollary, which is the important part.

Dr. Smith: We were not really trying to make that point here, but rather the more basic point that there was a rationale, a basic rationale, for government support of activities in the research and development field.

I might give you another quote if you are interested in this: This comes from Harry Johnson, who considered a number of theoretical aspects of this. Then he concluded that:

There is good theoretical reason for expecting that left to itself the market would not only tend to allocate too few resources to research in general, but would also tend to bias the allocation against scientific research as contrasted with applied scientific research.

But after noting that this expectation is substantially supported by the facts and also that a substantial allocation of public resources is in fact being made to research, he goes on to say:

The real question is . . .

and this is the question you are raising now and to which I do not really have an answer, but it is interesting that this question is arising in many places now:

The basic question is not whether the market system needs supplementation, by whether the degree of supplementation provided through existing non-market channels is adequate, too large, or too small in relation to the economically optimum and whether the resulting allocation of resources among rival fields of scientific inquiry is reasonably sufficient.

He poses the basic question here, but he did not answer it, and I do not have a good answer to that question either.

The Chairman: That is not the first time that Harry Johnson raised a question.

Senator Grosart: Of course that is what the ball game is all about, that very problem.

Has any study been made of the actual relationship in Canada between government funded R and D and

innovation—not so much a cost benefit type of analysis, but from the point of view of cause and effect?

Dr. Smith: No, not that I know of. One of the crucial questions here again, of course—one that makes it very difficult to undertake any such study—is that ultimately what is important, if science is to serve society, is how scientific knowledge is used and not how it is produced. We do not really have any good studies that I know of in Canada dealing with the use of scientific and technical knowledge as it effects economic activities.

Then, other difficult questions arise. In the first place, in Canada we are not going to be a large producer of scientific knowledge in the world context; we are going to be a small factor, and much of the knowledge that we are going to need to use effectively in Canada in innovation is going to have to come from abroad. That is where most of it is going to have to come from, where most of the new knowledge is going to develop. Therefore, it is very important to ensure good access to foreign sources of knowledge.

A corollary is that it makes it very difficult to assess, in any kind of meaningful way, what scale of resources you need in Canada. In a very real sense, to make international comparisons of the proportion of expenditures on R and D to GNP is virtually a meaningless operation.

The important thing is how you use R and D, not what you spend on it, you see.

Senator Grosart: Are you suggesting then that we should go rather more to the Japanese model than to the American model?

Dr. Smith: I am not sure I know enough about the two models to say.

Senator Grosart: By the Japanese model, I am playing back some of the information we have been given here. It is that the Japanese, up to now anyway, have relied to a great extent on a worldwide information gathering system and that their concern has largely been to find out what there is at the D level of R and D that they can take over and move on to the innovation level.

Are you suggesting that that might be—I am not saying this in a critical way—are you suggesting that perhaps because of the special problems we have here (the input of the American research from American parent companies and so on) are you suggesting that we might be wiser to go in that direction, rather than trying to build up too great a national capacity for research and development?

Dr. Smith: I am suggesting that maintaining very good knowledge of, and access to, foreign information in the R and D field should be an extremely important component of our policy.

Senator Grosart: Is it an important part of national science policy at the moment to your knowledge?

Dr. Smith: We do have a technical information system for gathering knowledge of this kind and disseminating it. I think that we need to have another good look at this whole area to see whether we are doing this adequately, to make sure that we are getting good access to information, to make sure that we are disseminating it to the right places—that is, to the places in which it can be used effectively.

More than that—and we drew attention also to this in our review—we felt that it was not enough just to get information on R and D activity abroad as well as we could and disseminate that, but also that it was very important to get information on the innovative end, on new processes that were developed. We suggested that our commercial counsellor service in Canada might be used more effectively to keep a watchful eye for new things that were developing in other countries.

Some of our most successful innovations in Canada in recent years have come from abroad. The oxygen steel process was developed in Austria; we stole it, in effect, and we ought to do a very good job at the innovative end in seeing what is developing elsewhere and whether it can be applied effectively in Canada.

The Chairman: Other countries have done so very effectively by us, too.

Senator Laird: It sounds like Harry Johnson now.

Senator Grosart: I have been impressed with the very excellent work that has been done over the years by NRC. They are actually operating some small factories, but they seem to be having tremendous difficulty in moving from the development stage into innovation. They tell us that if they go to big Canadian firms they are not interested. They gave us evidence of searches that usually wound up with a very small Canadian firm that was prepared to move in at this stage and do the innovation and market development.

I asked you earlier if there were any studies of this and I think you said, "no".

Dr. Smith: None that I know of, Senator.

Senator Grosart: It seems to me terribly important at some stage to have assessed all of this work that the NRC has done, so that some decision could be reached as to whether this is the right way to go about it.

Again we have the generalization that we must have less government inhouse R and D, but it is still a generalization. I do not see that there are any definitive studies on which this judgment is based.

The Chairman: But your chapter on science, technology and the economy was mainly devoted to raising questions and describing issues; you are not really attempting to give answers to these questions, or to solve them.

Dr. Smith: Yes, there are many questions unanswered after our first excursion.

The Chairman: For instance, on page 44 you say that greater efforts are needed in Canada towards improving our knowledge and understanding of the innovative process. Then on the following page this thing that we have just discussed, that we should have a better information service and then you go on saying that the government should assist industry more in its research activities and all this, but it was not your purpose to answer all the questions that we are trying to answer here?

Senator Grosart: No, but that is what we hoped we brought these gentlemen here for, because we certainly do not know the answers, Mr. Chairman.

The Chairman: Well, speak for yourself. I thought that one of the main purposes of our meeting with the Economic Council was to examine the role of the Economic Council in the framework of our total scientific effort and as an important agency of making research and advice in the field of economics, not to devote too much time to this chapter on science, technology and the economy because this is not the main responsibility of the Economic Council.

We have the Science Council and other agencies whose main responsibility it is to deal with these issues.

Senator Grosart: I find myself in a desperate state of frustration when I think of the time when we have to write a report, Mr. Chairman. That is why I ask anybody I think could give me a glimmer of hope.

Dr. Smith: Our own chapter was not without its frustrations too, sir.

Senator Grosart: For example, on page 42 I read:

Where the United States appears to have a large edge is in the ability to integrate R and D activity with the total innovative process . . .

and so on. I think we too know this to be so and we can assume that it is because they contract out so

many of their defence contracts on a total basis. Are there any lessons that we can learn from this?

Dr. Smith: I am sorry; could I get you to try to make this a little clearer for me; I am not sure I understand you.

Senator Grosart: My question is this: That having made the statement that the United States has a big edge on us and presumably on everybody else, are there any components to their advanced position that we can utilize to try and help our own situation?

Dr. Smith: I think that there are perhaps a few things that might be said. We took a look in this context at the importance of the innovative process, at what had been going on in the United States. We asked ourselves what seemed to be relevant from the US experience, what we could learn something from.

There is a list of factors here that summarizes this, on page 42:

In the United States, it has been suggested that a number of environmental factors may have greatly facilitated successful innovations and the creation of new technological enterprises. Among these have been:

We list several things here. One of them is:

venture capital sources that are 'at home' with technologically oriented innovators and have the rare business appraisal capabilities necessary to diagnose the prospects of translating a technical idea into a profitable business.

Essentially this is the question of the source of funds, sources of funds that are prepared to go into risks.

The second one is technologically oriented universities that can help to generate new technological ventures.

The third is that you need to have good entrepreneurs. This is something different than good business management.

Again you need to have individuals who are prepared to take the risks and try new things rather boldly.

I would think that this is one of the things that the Japanese have. They are particularly interested in new ideas; they like to apply new ideas; they do not wait for somebody else to see if something will work successfully before they are willing to have a go at it.

Then close, frequent consultations are useful among technical people, entrepreneurs, universities, and venture capital sources.

But difficult questions remain about how to get an effective mix, a dynamic mix of the ingredients that seem to work in the United States.

I think these are some of the things which have appeared in the United States that do have relevance for our situation.

We also put, of course, a particularly strong emphasis, on the role of management. This may be very important in the Canadian context at this stage. There are not very good up-to-date studies on this. But from the limited evidence available, it would appear that the quality of Canadian management may not be as high as that in the United States—at least as measured, for example, by the number of years of schooling. We appear to have a wider gap in the educational stock in the managerial occupations and the professional occupations between Canada and the United States than between other occupations.

If you go to production workers, or clerical workers, or other occupation groups, the education gap is narrower.

In the management area this gap appears to be particularly wide, something in the area of three years. On the average every US manager has about three years more education than a Canadian manager.

We pointed out in the Firth Review that we are in a situation now in which the demand for managers is expanding very rapidly. It is likely to continue to expand very rapidly because our labour force is growing very rapidly, much more so than the United States. We are in a situation in terms of the age structure in our population in which the number of people in the 35-45 age group is now declining absolutely. That is the age bracket from which a good deal of middle management, at least, tends to be drawn.

We also pointed out that the business school education system in Canada is much less developed than that in the United States; that in relation to the relative size of the populations we were producing about a quarter as many BA's in the business schools and the schools of commerce, at the MBA level about one seventh of that in the United States in relative terms, and that up to the fall of 1968 we have produced PhD's in Canada's history in the business field.

Now, business managers are not all drawn from the business school background; they are drawn from many backgrounds, but in this area of training people—and it is an area from which management talent is being increasingly drawn—we have not had a very good performance in our educational system.

This again is in a process of rapid change and development; it is developing very rapidly in Canada now, but it is late.

Senator Bourget: Was it due to a lack of good school facilities or good business administration schools? What is the reason for that? There is a difference of one to four.

Dr. Smith: I am not sure that we have a very good answer to that now. We have a study that is being undertaken on the business schools in Canada by Mr. von Zur-Muchlen. We hope to have this completed in the not too distant future, and if we have found some answers to that question we will certainly include them in the study and make them available.

Senator Yuzyk: Dr. Smith, regarding education and education is, I think, a very important factor as far as science policy is concerned, economic policy and all kinds of policies. We have been paying a great deal of attention to the higher education, universities, well, I will say business schools and the like, and I do not think we have ever discussed the matter of these policies particularly affecting as they would affect our educational system, or our educational systems, shall I say, in various provinces.

We do not have even a coordination of our educational systems across the whole country.

Have you given any thought, has the Council given any thought to the development say within our educational systems and bringing the present generation closer to these innovations that sometimes just come upon us suddenly and even the population is not prepared for them? That is where we lack people who are ready to go into positions, or prepare themselves to go into say managerial positions if they do not even realize that there is such a necessity.

Has there been any thought given at all to say the secondary level of education, what the Council can do in that respect?

Dr. Smith: Although we have done quite a bit of work in the field of education, we feel that we are still very much scratching the surface of the field. It is a very large and complicated field.

What we have done in terms of education in the formal educational system is to try and develop a view of how this has developed over the years. What we have found is simply this, that coming into the 1960s we had a very poor educational basis and performance in Canada in relation to what we should have had.

At that point in time we had had for 50 years, about half a century, a gradually widening gap in educational attainments in the labour forces between Canada and the United States.

We had at that time, as of the 1961 census, something in the order of half of our whole Canadian

male labour force that had no more than Grade 8 education. We had at that stage come through a period in which the rate of improvement in educational attainment in the labour force in the 1950's had not only been moving more slowly than in the United States, but also more slowly than in most European countries.

What became increasingly clear was that we had not made adequate efforts—stretching back over several decades, not just for a few years, but several decades—in our educational system.

What seems to have happened is that we matched the United States very closely in the latter part of the 19th century and early 20th century when both countries were engaged in getting young people through the reading, writing and arithmetic stage in elementary schools, giving them an elementary school education.

Back before the first world war the educational attainments of the labour forces of the two countries were not too different. But in the 1920s the United States went on to put increasing emphasis on getting young people into the high schools. In contrast, our efforts fell off; we got large drop-out rates at the end of the elementary schools in the 1920s. A great many of these people are still in the labour force now. In other words, if you have a slow down of this kind, it casts a long shadow forward.

Then we picked up momentum in the secondary schools in the post-war period. But by that stage the United States was going on to put great emphasis at the university level. Again, we failed to match the U.S. efforts, so that in relation to our population we have something in the order of half as many university graduates as the United States.

As late as 1950 or so, we still had less than half of our 14 to 17 year old children in school. The big high school development did not come until the 50's.

Now, of course, in the 60's we have got our high school enrolment ratios well up in the 14 to 17 year group; perhaps around 85% are now enrolled in schools. And we are now trying to get a very rapid increase at the university level.

The great burst of expansion in university students is coming not from the age bulge, not from the fact that we have much larger numbers of young people of university age, but from the rising enrolment ratios of young people going on to university at this stage. We estimated that something like four-fifths of the expansion in university involvement is coming from rising enrolment ratios and not from the age bulge.

So what we are really doing in the 1960s is trying to catch up, in a short period of time, on things we should have done a long time ago. This is going to

mean a major change for the future, because it is going to have very major implications for higher labour quality in Canada in the 1970s and beyond—indeed, for decades ahead.

Senator Yuzyk: Have you been looking into the revision of the curricula, for instance, in the various provinces?

Dr. Smith: No, we have not been doing that.

Senator Yuzyk: Do you not think probably we should be looking into that too if we want to prepare our society for what we think is in store for them?

I think that this is something that we lack very badly.

The Chairman: You have proposed further studies?

Dr. Smith: We propose further studies and we are undertaking a series of studies in the educational area ourselves. For example, we are exploring in collaboration with the Vanier Institute a joint study to look at another very important area; namely, the pre-school area.

There is increasing evidence to suggest that to a very large extent a child's educational capacities and ultimate intellectual attainments are determined before entering the elementary school, while still in the family.

So we have joined with the Vanier Institute to consider doing a study which would pull together the information in this area to see if we can make some assessment of it.

The Chairman: This would be a new association of the Council, to be closely associated with the Vanier Institute?

Dr. Smith: Yes, Such collaboration can, I believe, serve a useful purpose in an important field of work, on the basis of an association that will be mutually advantageous.

The curriculum problem is a more difficult one; this touches really on the question of what kinds of skills and occupations we may need in the future, and thus far the efforts that have been attempted in various parts of the world to project occupational requirements for length of time into the future have not been very promising.

The speed of change, the speed at which occupational groups are changing in the modern world, is such that this is a very difficult thing.

Senator Yuzyk: But the direction is very evident, is it not, in certain fields?

Dr. Smith: One of the things that is emerging in many educational systems is the development of the educational system itself to provide a basis for learning family of skills in certain areas which will provide a much greater chance for adjustability.

The greatest security in employment in the future is not going to come from learning a particular skill; it is going to come from being adaptable and having the capacity to acquire a new skill—if necessary to learn a totally new skill to fit rapidly changing skill requirements in our economic system.

Senator Yuzyk: We will have to be giving some thought too to our educational systems, because the secondary school systems right across the country have different emphases and different curricula and I think that they are looking for some kind of leadership or direction, because they are not capable of it.

The Chairman: From the federal government?

Senator Yuzyk: From the parochial point of view and I think some body such as the Science Council should bring together representatives of the departments of education, or even the Ministers of education, to make them realize even in discussion what is ahead.

The Chairman: I wish you good luck on that one.

Dr. Smith: We did play some small part at the last educational conference sponsored by the provincial ministers of education, which was held two or three years ago. That was a very useful exercise; there had been some hope I think that some office of education might emerge as a result of provincial cooperation from that conference which might deal with the kind of question you are raising, looking at curricula more carefully.

Senator Yuzyk: But nothing has developed beyond these suggestions?

Dr. Smith: Nothing has developed.

Senator McGrand: When you speak of skills developed by technology, does technology keep up with the needs of the industry or does it precede it like the shadow that is cast before it and force industry to adopt these innovations of technology? Which comes first?

Dr. Smith: That is a very difficult question; the consensus of view seems to be that technology, especially the innovation part, tends to develop in response to need, that it is a sensing of new needs and opportunities.

The Chairman: I must warn you that this is very Marxist.

Dr. Smith: Is that so?

Rather than the other way round; that somebody dreams up a bright idea and that that is the thing that produces the initiative to get something changed.

It is the sensing of an opportunity, a new product, a new process, something that cuts costs, something that will appeal to customers. That I think, on the whole, probably tends to lead most readily to innovation.

Senator McGrand: It always seems to me that industry is forced into a position of adopting these technological advances, as they call them.

Then you have unemployment on your hands, you have displacement of population, you have a lot of things that probably would not have happened if that technological advance had not been there to tempt them to use it.

Dr. Smith: We used to hear a great deal, especially back around 1960 and 1961—when we had 7% unemployment in our economy we used to hear a great deal in those days about the fact that rapid technological change would produce mass unemployment. But we have heard much less about it in recent years, when we have come through an enormous expansion, with a much more rapid process of technological change taking place in our economy than at that stage, and we have not produced mass unemployment as a result.

However, one of the most important things is that technological change does impose burdens and hardships on individuals who are forced to adjust as this comes along. This is one of the main reasons why the Economic Council has been very much concerned about this issue and has spoken about the importance of adjustment policies.

Indeed, we put out a special declaration by the Council for a labour-management conference which we held—a declaration on adjustment to technological and other change, that suggested that there were responsibilities that business people should have, that labour unions should have and that government should have to make the process of technological change work in such a way that it would not impose undue hardships on individuals.

Senator Grosart: On the subject of innovation, you made your recommendation, which appears on page 16 at the head of your list, that innovation, the crucial stages beyond R and D, be given greater recognition in science policy.

I am sure this is not just a pious hope; it is a recommendation. Now, if you were asked to go farther from the R and D stage here, into the innovation stage, and advise government as to how this should be done, along what lines would your advice run? Would it be the United States total government contract system, the French system of stating targets and saying if industry reaches these targets they will do R and D funding? Should it be by subsidy incentive, or along the lines of the U.K. Ministry of Technology, that if you reduce the number of your establishments we will fund your research so that you can compete with your competitors abroad? What emphasis would you put on these as an operative science policy to achieve this objective?

Dr. Smith: Again I would draw a distinction here between what we were trying to say about the importance of greater emphasis on the innovative process and things that would encourage this and the R and D effort.

The earlier programs, and some of the other things you were talking about, are more concerned with the R and D end than the innovation end.

On the innovation end, as I tried to emphasize in my introductory remarks, we still really have a lot to learn about what produces good innovative performance. Here we came down with a conclusion along the lines, again as I indicated at the outset, that you need such things as a good competitive pressure working in your system that encourages people to innovate, that exposes them to discomforts and troubles at times, so that there is more incentive to look around and say: "Can we cut costs? Can we become more competitive in some way? Can we develop a new product?"

Senator Grosart: Surely we have enough of those in our economy? We do not need any more of those, do we?

The Chairman: I think, Senator Grosart, I have been a very poor chairman this afternoon, because I tried for once to direct the discussion a little bit; I was completely unsuccessful. I thought that this examination of this special chapter was only really part of the exercise this afternoon, but a relatively minor part, the main part being to try to have a look at the way the Economic Council has exercised its role and functions and responsibilities, but I have not been able to ask too many questions about this.

Dr. Smith: It sounds like everybody is satisfied with that, Mr. Chairman.

The Chairman: I do not know; I will give you a choice, Dr. Smith: Either you will have to come back and answer some questions with respect to this or, since you intend to review after five years of

existence your role and your activities perhaps you could give some thought of inviting me there.

So you will have your choice; whenever you are ready to give me an answer then I will either try to write my own views and be prepared for your seminar or we will have to negotiate for you to come back.

In the meantime I would like to thank you very much for spending this afternoon with us and answering the questions of the members of the Committee, including the undisciplined member, Senator Grosart!

The committee adjourned.

APPENDIX 26

BRIEF

TO THE SPECIAL COMMITTEE ON SCIENCE POLICY

OF THE SENATE OF CANADA

FEBRUARY 1969

Submitted by
Arthur J. R. Smith,
Chairman, Economic Council of Canada

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BRIEFTO THE SPECIAL COMMITTEE ON SCIENCE POLICYOF THE SENATE OF CANADAFEBRUARY 1969

Submitted by
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Chairman, Economic Council of Canada

TERMS OF REFERENCE OF THE ECONOMIC COUNCIL

1. The Economic Council of Canada was established by Act of Parliament (12 Elizabeth II, Chapter 11 -- see Appendix I) assented to on August 2, 1963.
2. The Council is an economic advisory body with broad terms of reference. The central feature of the Council's duties is "to advise and recommend ... how Canada can achieve the highest possible levels of employment and efficient production in order that the country may enjoy a high and consistent rate of economic growth and that all Canadians may share in rising living standards; to recommend what government policies ... will best help to realize the potentialities of growth of the economy; to consider means of strengthening and improving Canada's international financial and trade position; ... to study how national economic policies can best foster the balanced economic development of all areas of Canada;"
3. Outside of its responsibilities to study and advise on the problems and potential of the Canadian economy, Section 11 of the Economic Council Act sets out certain additional duties of the Council, designed to promote productivity gains in all sectors of the economy.
4. In addition to the duties set out in Sections 9 and 11 of the Economic Council Act, Parliament made provision for the Council to undertake special studies at the request of the Government in areas that fall within the purview of its general terms of reference. In its first five years, the Council has had two such References. In its first Reference, the Government asked the Economic Council to launch an examination into prices, costs, incomes and

productivity and their relationship to sustained economic growth. The Council reported to the Government and to the Canadian public on this Reference in its *Third Annual Review*. A second Reference from the Government asked the Council --

"In the light of the Government's long-term economic objectives, to study and advise regarding:

- (a) the interests of the consumer particularly as they relate to the functions of the Department of the Registrar General (now the Department of Consumer and Corporate Affairs);
- (b) combines, mergers, monopolies and restraint of trade;
- (c) patents, trade marks, copyrights and registered industrial designs."

An interim report under Section (a) of this Reference was published in July 1967. A second interim report under Section (b) is presently in preparation for release sometime this summer.

5. In establishing the Council as a separate Crown Corporation, with a widely diversified membership from the private sectors of the economy and with the right to publish without prior concurrence of the Government, Parliament has conferred a large degree of independence on the Council.

6. The Council does not have any operational responsibilities. It does not implement or administer any policies or programs. It does not have the authority to make research grants, although it may make contractual arrangements with persons other than its staff for the purpose of advising and assisting the Council in the performance of its duties.

MEMBERSHIP OF THE COUNCIL

7. The Council consists of up to twenty-eight members appointed by the Governor in Council (for a list of current members, see Appendix I). These include a chairman and two directors who serve full time in their professional capacity and up to twenty-five members who are selected from industry, labour, finance and commerce, agriculture and other primary industries, and the general public. The chairman and the directors (one of whom is elected as

vice-chairman by the Council) are appointed for seven-year terms. The other members are appointed for three-year terms "after consultation with appropriate representative organizations" and are intended to reflect a very wide diversity of interests from the different private sectors of the economy and different regions of the country, but they sit on the Council as individuals and not as delegates of particular organizations or groups. The Council is therefore a mixed body rather than an expert professional body, although it is served in its deliberations by an expert staff. There are no government members appointed to the Council. Under the Act, the chairman is the chief executive officer of the Council and has supervision over, and direction of, the work and staff of the Council.

PUBLICATIONS OF THE COUNCIL

8. The publications policy of the Economic Council is based on two provisions of the Act, one that requires the Council to publish annually a review of the medium- and long-term prospects and problems of the Canadian economy, and a second that empowers the Council to publish, as it sees fit, such studies and reports prepared for its use. These provisions enable the Council to carry out a most vital function, namely, the dissemination of information to the public as a means of stimulating informed appraisal and discussion of economic problems and policies.

9. The Council's publications (see Appendix III) fall into three broad categories:

- (1) The Annual Reviews which summarize the results of the Council's studies and present its conclusions and recommendations (five of which have been issued to date);
- (2) Staff and Special Studies which provide more detailed statistical, technical, and analytical results of the various research projects; and
- (3) Conference papers and other reports.

RESEARCH POLICY

10. From its inception, the Council has attempted to further articulate and clarify the basic economic and social goals implicit in its Act. Virtually all the analysis and conclusions of the Council's Annual Reviews (as well as other aspects of its work) have emerged from the basic concern with five economic and social goals: full employment, sustained economic growth, reasonable price stability, a viable balance-of-payments position, and an equitable sharing of rising incomes. By defining and clarifying these goals as medium-term objectives to be simultaneously attained, the Council has sought to portray the potential of the Canadian economy over a number of years ahead, and to assess the performance and actual progress of the economy towards its potential.

11. The Council meets four or five times a year to consider progress on work previously authorized, to authorize new work, to reach a consensus about its Annual Reviews, and to discuss various aspects of its activities and duties. Analytical papers prepared for the use of the Council are subjected to careful professional review, both within the Council staff and, occasionally, by outside experts. Special care is taken to assure the maximum degree of consistency and cohesion in the Council's over-all research program. Papers based on such research are brought forward to Council where their policy implications are explored. When the Council is satisfied with the analysis undertaken for its Annual Reviews, it may then instruct its staff to prepare draft chapters for these Reviews. These draft chapters are then discussed at subsequent Council meetings in the context of the preparation of the final versions of the Reviews. Additional research work is authorized in support of Council conferences as well as to assist the Council on special Government References. The Council attempts to achieve a consensus on policy advice and recommendations on the basis of an agreed-upon, consistent body of analysis. The terms of reference for such analysis are determined on the basis of discussions and decisions by the members of the Council.

STAFF AND PERSONNEL POLICIES

12. The Council is assisted by a staff of approximately 120 persons, including about 60 professional and administrative officers, drawn from a wide variety of former positions with the federal government departments, other federal agencies, provincial governments, universities, business firms, labour unions, and international institutions. The wide range of training, experience and knowledge of the staff reflects the wide terms of reference given to the Council. In spite of these wide terms of reference, there has been a deliberate attempt to keep the over-all size of staff relatively small and to expand it relatively slowly in order to maintain strength and consistency in the work of the Council.

13. The qualifications and some additional information on the Council staff as requested in the Guide for Submission of Briefs are set out below in tabular form. Table 1 traces the growth of the professional and administrative establishment (according to salary classifications) from 41 in the Council's first year of operation to 59 in the current year. Table 2 provides certain information on the professional staff directly associated with scientific activities in fiscal year 1967-68.

14. No staff titles are employed at the Council. Senior members of the staff may be assigned specific responsibilities, as well as more general responsibilities for co-ordinating the development of information and analysis in certain broader areas of work.

15. From time to time, the Council has conducted intramural courses to upgrade the knowledge of the entire professional staff. Such courses usually call upon visiting professors and experts in the related areas. For example, the Council has conducted courses on input-output analysis and computer technology. In addition, the Council has invited outstanding authorities to conduct staff seminars on subjects in which it has particular interest. For example, during the past year, such seminars have been conducted by

Arthur Okun, Chairman of the Council of Economic Advisers in the United States; Professor K. Ohkawa of Hitotsubashi University of Tokyo; Saburo Okita, Director of the Japan Economic Research Center; Professor Christopher Freeman, Director of the University of Sussex, Unit for the Study of Science Policy; Professor Jan Tinbergen of the Netherlands; and Professor Wassily Leontief of Harvard University.

16. Because of the heavy workload under which the Council has been operating, it has not been possible to make extensive use of educational leave as a technique for upgrading the Council staff. However, educational leave has been provided to two officers of the Council to study, respectively, in France and in Britain. In addition, the Council has paid 50 per cent of the tuition fees for courses being taken by professional members of the staff at universities on their own time, as well as assuming part of the cost of specialized courses of two to three weeks' duration in such areas as computer sciences, t-group training, etc. Various members of the staff have passed through several levels of language courses provided by the government.

17. In addition to the in-house research conducted by Council staff, the Council is authorized to engage the services of outside experts from universities and elsewhere to advise and assist in its work. Considerable use has been made of this authorization over the past five years -- indeed, in one way or another, the Council has already benefited from past participation by more than 100 university and other experts in certain aspects of its work. The Council has followed the practice of having competent outside experts act as readers for both staff studies as well as studies undertaken on its behalf by other outside experts.

18. The Council, through its outside contracts for research studies and use of academic readers, has extensive contacts with the academic world. From time to time, it also has meetings with academic groups in different parts of the country. Indeed, a wide variety of contacts with the universities has served

Table 2

Selected Characteristics of

Professional Staff Associated with Scientific Activities

Classified According to Highest Degree	Country of Birth	Country in Which		Working Years since Graduation	Years Employed in Present Organization	Average Age	Official Languages
		Secondary Education Taken	University Degree Taken				
<u>Bachelor</u>							
14	9 Canada	10 Canada	13 Canada	17.1	3.3	37.5	12 E 2 EF
	2 Germany	1 Germany					
	1 Indonesia	1 Netherlands	1 Netherlands				
	1 England	1 England					
	1 New Zealand	1 New Zealand					
<u>Master</u>							
13	8 Canada	8 Canada	9 Canada	8.7	2.4	36.8	10 E 3 EF
	2 England	2 England	2 England				
	2 India	2 India	1 India				
	1 Germany	1 Germany	1 U. S.				
<u>Doctorate</u>							
10	7 Canada	7 Canada	8 U. S.	12.3	3.6	42.8	8 E 2 EF
	1 U. S.	1 U. S.	1 England				
	1 Germany	1 Germany	1 Hungary				
	1 Hungary	1 Hungary					

many useful purposes -- including the eliciting of interest in, and assessment of, the Council's work and the facilitating of recruitment of new staff. Also, the Council's documents have come to be increasingly used for teaching purposes in various universities. Since the Council does not have any grant-making capacity, it does not play any supporting role in economic and social research in Canadian universities *per se*.

19. A limited amount of summer employment is provided for undergraduate students who come highly recommended from their respective economic faculties. Such temporary employees work directly under supervision of senior members of the Council staff who make an assessment as to their future potential with the Council.

FINANCIAL ADMINISTRATION

20. The Council is a Crown Corporation and operates under Schedule B of the Financial Administration Act. All amounts required for salaries and other expenses are paid out of monies appropriated by Parliament for that purpose. The Council spent approximately \$170,000 between August 2, 1963 and March 31, 1964, in the process of organizing its staff and operations. A statement of expense for each of the next four fiscal years is set out in Table 3.

Table 3

STATEMENT OF EXPENSE

for the years ending March 31, 1965-68

	1965	1966	1967	1968
Administration:				
Salaries	\$ 643,165	\$ 819,754	\$ 1,013,151	\$ 1,055,637
Employee benefits	40,500	50,900	60,200	116,600
Professional and special services	68,408	69,864	164,984	91,402
Accommodation	63,202	73,300	80,300	85,000
Travel and removal	66,235	61,993	50,902	50,704
Office stationery, supplies and equipment	25,311	36,702	41,463	46,884
Publication of reports and studies	17,123	12,099	24,582	31,438
Telephones and telegrams	10,898	16,060	15,897	14,639
Accounting and cheque issue services	3,800	7,000	8,400	10,000
Postal services and postage	5,848	6,632	3,717	3,532
Miscellaneous	2,449	14,947	15,467	16,622
	<u>946,939</u>	<u>1,169,251</u>	<u>1,479,063</u>	<u>1,522,458</u>
Special studies and references:				
Salaries	---	42,947	74,710	77,191
Professional and special services	---	39,025	29,825	102,746
Miscellaneous	---	2,840	4,587	---
	---	<u>84,812</u>	<u>109,122</u>	<u>179,937</u>
Total Expense	\$ 946,939	\$ 1,254,063	\$ 1,588,185	\$ 1,702,395
Total expense provided for by:				
Privy Council	817,920	1,103,409	1,279,824	1,487,595
Department of Finance	68,000	12,954	156,061	---
Government departments which provided major services without charge:				
employee benefits, accommodation, accounting and postal services	113,202	137,700	152,300	214,800
Less amount not required	(52,183)			
	<u>\$ 946,939</u>	<u>\$ 1,254,063</u>	<u>\$ 1,588,185</u>	<u>\$ 1,702,395</u>

RELATIONS WITH OUTSIDE BODIES AND GROUPS

21. In carrying out its research and policy advisory functions, the Council maintains very close working relationships with various federal departments and agencies. It has worked particularly closely with the Dominion Bureau of Statistics which provides the great bulk of the statistical information required for the Council's analytical work.

22. The Council has also maintained contacts with provincial economic advisory bodies, and with officials in provincial governments. Such contacts represent an explicit response to the duty, set out in the Economic Council Act, "to seek full and regular consultation with appropriate agencies of the governments of the several provinces".

23. Since the Council is attempting to define a policy planning framework which has relevance not only for the public sector but for the private sector as well, it has developed extensive contacts with industry and other private groups. In part, such contacts help to provide useful information for some aspects of the Council's work -- for example, as a basis for the Council's medium-term investment surveys and for its study of manpower planning in industry. In part, such contacts also provide a basis for testing the relevance of the Council's work to private decision-makers. Other contacts with industry have resulted from the pursuit of the Council's responsibilities for improved labour-management relations in areas that impinge upon the realization of the economy's economic potentials. The Council, for example, has held two national labour-management conferences which have dealt with a variety of subjects on which research has been undertaken in anticipation of the conferences. These are only illustrative of a wide variety of contacts with many different groups across the nation. In fact, the relevance of the Council's work is constantly under review at numerous meetings with management, labour, farm, academic and other groups throughout the country.

24. No specific process of review has been instituted to explore the operational effectiveness, duties and goals of the Council. Since the results of the Council's work are published, opportunities are readily available for public criticism of the manner in which the Council is attempting to fulfil its obligations.

25. The Economic Council was established by Parliament as an institutional response to the recognized need for strengthening the base of information and advice relevant to the achievement of challenging national economic and social goals. This is no easy task, especially in a country such as Canada, with its wide regional differences, its highly decentralized system of private decision-making, and its constitutional system in which very important economic policy powers are divided between the federal and provincial governments. But the Council has sought to make at least a beginning at providing the kinds of information and analyses that would lead to a better understanding of our economic system and enable decision-makers in many parts of the economy to plan more effectively. Many elements in the private sector in the Canadian economy have found such a framework useful. The same can be said for many elements in the government sector in the Canadian economy -- for example, some provinces take the goals as defined by the Economic Council, as well as the Council's estimates of the potential of the Canadian economy, explicitly into consideration in various aspects of policy formulation.

26. Among other relations with outside bodies, the Committee may be especially interested to note that a direct link exists between the Economic Council and the Science Council, since the Chairman of the former is an associate member of the latter. In addition, there has been close and continuing consultation between the staff members serving the two Councils on various matters; and recently there has been an exchange of personnel.

THE NEED FOR BETTER INFORMATION

27. In the work of the Council it has become essential to use increasingly sophisticated and comprehensive analytical tools to develop a growing understanding about how the economy works, and about how to make it work better to serve the needs and aspirations of Canadians. These tools, in turn, require high-quality and extensive statistical information if they are to be used effectively. Canada's statistical information systems are now being pressed to their very limits in many fields of analysis, and important deficiencies are becoming apparent. In short, better information has become indispensable to better decision-making in both the private and government sectors of a nation aspiring to achieve high standards of economic performance. In its *First Annual Review* the Council summarized this issue in the following terms:

In government, business, and labour there is an urgent need for more extensive and more long-range economic analysis. The Economic Council will help to fill this need by providing a framework within which more specific long-term analysis can be undertaken by others. But to facilitate the development of such longer term analysis -- in fact, to facilitate our own work in the Council -- a substantial increase in resources is required to improve and extend basic information and economic statistics.

The Royal Commission on Government Organization urged that much greater resources must be provided for the Dominion Bureau of Statistics. We wish to support strongly this recommendation. Over the post-war period much of the improvement which has taken place in our basic economic statistics has been tailored to the needs for better data for short-term economic analysis. This now needs to be supplemented by a major improvement in the data which are particularly relevant for both longer term and regional analysis.

28. The organization of information in a meaningful way into statistics is an important national function. In the economic and social fields, much of this function in Canada devolves upon the Dominion Bureau of Statistics. The economic information system now provided by the Dominion Bureau of Statistics has grown enormously over the past two decades but the demands placed upon it have grown even more rapidly. The quality of much of this economic information has been greatly improved, but the quality required for good decision-making in relation to more demanding and sophisticated

objectives in our economic system has also increased greatly. The basic framework of statistics must be adjusted in a continuing way in response to rapidly changing requirements for data under rapidly changing conditions -- the curtailment and elimination of statistics whose usefulness has substantially declined and the swift development of new statistics to meet important new needs. The tolerances at the decision-making level have become finer, and error factors which might have been regarded as tolerable a few years ago are no longer acceptable. The resources involved in strengthening the statistical basis for government and business economic decision-making are likely to be insignificant in relation to the possible losses that may otherwise occur in our economy.

29. The urgings for improvement in our basic economic information systems have come from many sources -- for example, the Special Joint Committee of the Senate and the House of Commons on Consumer Credit, in its interim report (see page 2180) in December 1966, made a series of recommendations to improve Canada's statistical information system. The Governor of the Bank of Canada in his various Annual Reports (see for example the 1966 Report, page 8) has indicated how the lack of timely information has led to difficulties in formulating and applying appropriate policies. Similar points were made in the Royal Commission on Taxation Report (see Volume II, page 83) and in the previously mentioned Royal Commission on Government Organization. The Economic Council again, in its *Third Annual Review*, called for the need for new and better statistics (see pages 187 to 189). Implicit in all of these recommendations for strengthening our basic economic information systems is the judgment that high rates of economic return will flow from development of improved information. In short, the benefits which can be expected from improvements in statistical information are likely to greatly exceed the costs involved.

30. The fundamental role which the Dominion Bureau of Statistics has to play in the Canadian economy should be more widely and fully appreciated throughout this country if we are to attain the growing benefits which can accrue to our whole society from an improved information base. It should be a matter of high priority in federal government decisions to make sure that this organization has an adequate capacity to acquire the growing resources which it needs. In particular, this priority is crucially important to maintain an appropriate environment for expanding and upgrading the most important resources of all those required in the Bureau's work, namely, the very scarce and increasingly skilled and knowledgeable manpower without which a high-quality statistical system cannot be maintained.

SCIENCE, TECHNOLOGY AND THE ECONOMY

31. From the beginning of its work, the Council has been centrally concerned with problems associated with growth and change. Growth essentially involves change, and technological change has been, and will continue to be, an important factor in the longer-term growth and development of Canada. The Council has consistently emphasized the role of science and technology in the economy. In its *First Annual Review*, published in 1964, the Council concluded that, with respect to R & D activities, "the most urgent need for further rapid development pertains to universities and private industries". It was with this concern in mind that, in its first year, the Council set up an Advisory Committee on Industrial Research and Technology to consider the role of research and technology in Canadian economic growth. In December 1965, the Committee's recommendations concerning federal incentive programs to encourage research and development in Canadian industry were published by the Council (a copy of which is appended for your interest*).

* Maxwell W. Mackenzie, the Chairman of the Advisory Committee on Industrial Research and Development of the Economic Council of Canada, appeared before this Committee on October 9, 1968.

32. In the Council's *Fifth Annual Review, The Challenge of Growth and Change*, a Chapter was devoted to "Science, Technology and the Economy". In this Chapter, the Council discussed certain economic aspects of science and technology -- the relationships of technological change and innovation to economic growth, some of the determinants of technological advance, the management and diffusion of scientific and technical knowledge to facilitate better business performance, the underdeveloped state of the social sciences in Canada, and the problem of allocating resources to maximize the returns from investment in scientific and technological activities. Since a copy of this Chapter is appended, only a very brief summary of the recommendations contained therein are set out below. The Council recommended:

- (1) that *innovation* -- the crucial stages beyond R & D -- be given greater recognition in "science policy";
- (2) that the capacity for Canadian business management to undertake successful innovation be strengthened;
- (3) that new and more effective means be developed to harness information on science, technology and innovation, both from abroad and from Canadian sources, in both the public and private sectors;
- (4) that Canada's indigenous scientific and technological effort be strengthened, particularly in industry;
- (5) that support for the social sciences be greatly increased, and that "science policy" should have regard to the need for more interrelated activities across the whole spectrum of research, including the natural sciences, the social sciences and the humanities.

ANNEX I

12 ELIZABETH II.

CHAP. 11

An Act to provide for the establishment
of an Economic Council of Canada.

[Assented to 2nd August, 1963.]

HER Majesty, by and with the advice and consent of the
Senate and House of Commons of Canada, enacts as
follows:—

SHORT TITLE.

1. This Act may be cited as the *Economic Council of Canada Act*. Short title.

INTERPRETATION.

2. In this Act,
(a) "Council" means the Economic Council of Canada established by section 3; and Definitions.
"Council."
(b) "Minister" means such member of the Queen's Privy Council for Canada as may be designated by the Governor in Council to act as the Minister for the purposes of this Act. "Minister."

COUNCIL ESTABLISHED.

3. There is hereby established a corporation to be known as the Economic Council of Canada, consisting of a chairman, two directors and not more than twenty-five other members, to be appointed by the Governor in Council as provided in section 4. Establishment and constitution.

4. (1) The chairman of the Council and each of the directors shall be appointed to hold office for a term not exceeding seven years. Appointment of chairman and directors.
(2) Each of the other members of the Council shall be appointed after consultation with appropriate representative Appointment of other members.

representative organizations to hold office for a term of three years, except that of those first appointed not less than one-third shall be appointed for a term of two years and not less than one-third shall be appointed for a term of four years.

Eligibility
for reappoint-
ment.

(3) A retiring chairman, director or other member of the Council is eligible for reappointment to the Council in the same or another capacity.

CHAIRMAN, DIRECTORS AND MEMBERS.

Salaries of
chairman and
directors.

5. (1) The chairman of the Council and each of the directors shall be paid such salaries and expenses as are fixed by the Governor in Council and shall devote the whole of their time to the performance of their duties under this Act.

Travelling
and living
expenses.

(2) The other members of the Council shall serve without remuneration but are entitled to be paid reasonable travelling and living expenses while absent from their ordinary place of residence in the course of their duties under this Act.

Remunera-
tion for
additional
duties.

(3) Notwithstanding subsection (2), a member of the Council other than the chairman or a director may, for any period during which he performs, with the approval of the Council, any duties on behalf of the Council in addition to his ordinary duties as a member thereof, be paid such remuneration therefor as may be authorized by the Governor in Council.

Quorum.

6. A majority of members constitutes a quorum of the Council.

Vacancy.

7. A vacancy in the membership of the Council does not impair the right of the remainder to act.

Vice-
chairman.

8. (1) The Council may, with the approval of the Governor in Council, designate one of the directors to be vice-chairman of the Council.

Absence,
etc., of
chairman.

(2) In the event of the absence or incapacity of the chairman or if the office of chairman is vacant, the vice-chairman has and may exercise and perform all the duties and functions of the chairman.

DUTIES.

Duties of
Council.

9. It shall be the duty of the Council to advise and recommend to the Minister how Canada can achieve the highest possible levels of employment and efficient

production

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Economic Council of Canada.

Chap. 11.

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production in order that the country may enjoy a high and consistent rate of economic growth and that all Canadians may share in rising living standards; and in particular it shall be the duty of the Council:

- (a) regularly to assess, on a systematic and comprehensive basis, the medium term and long term prospects of the economy, and to compare such prospects with the potentialities of growth of the economy;
- (b) to recommend what government policies, in the opinion of the Council, will best help to realize the potentialities of growth of the economy;
- (c) to consider means of strengthening and improving Canada's international financial and trade position;
- (d) to study means of increasing Canadian participation in the ownership, control and management of industries in Canada;
- (e) to study how economic growth, technological change and automation, and international economic changes may affect employment and income in Canada as a whole, in particular areas of Canada and in particular sectors of the economy;
- (f) to study and discuss with representatives of the industries concerned and with representatives of labour, farmers and other primary producers, and other occupational groups and organizations, what specific plans for production and investment in major industries in Canada will best contribute to a high and consistent rate of economic growth;
- (g) to study how national economic policies can best foster the balanced economic development of all areas of Canada;
- (h) to explore and evaluate particular projects of major significance for the expansion of industrial and other economic activities in Canada, whether or not such projects may involve direct governmental participation, and to make recommendations concerning those projects that in the opinion of the Council will contribute to the growth of the Canadian economy;
- (i) to encourage maximum consultation and co-operation between labour and management in the fulfilment of the objectives of this Act;
- (j) to seek full and regular consultation with appropriate agencies of the governments of the several provinces; and

(k)

- (k) to conduct, if directed to do so by the Minister, reviews of medium term or long term programs of the Government of Canada that are designed to aid or assist industry, labour or agriculture.

Initiation of studies, etc.

10. The Council shall on its own initiative, or if directed to do so by the Minister, conduct such studies, inquiries and other undertakings as may be necessary with respect to any matter coming within paragraphs (a) to (k) of section 9 or with respect to any other matter or thing for or relating to the carrying out of its duties under that section, and shall report to, advise or make recommendations to the Minister with respect thereto, as the circumstances require.

ADDITIONAL DUTIES OF COUNCIL.

Additional duties.

11. (1) In addition to its other duties under this Act the Council shall, for the purpose of promoting and expediting advances in efficiency of production in all sectors of the economy,

- (a) foster and promote
 - (i) the development of improved production and distribution methods,
 - (ii) the development of improved management techniques,
 - (iii) the maintenance of good human relations in industry,
 - (iv) the use of training programs at all levels of industry, and the use of retraining programs to meet changing manpower requirements,
 - (v) the extension of industrial research programs in plants and industries as a means of achieving greater efficiency of production, and
 - (vi) the dissemination of technical information; and
- (b) organize, assist and enlist the aid of committees, teams and other groups in the implementation of programs designed to give effect to any of the objectives set forth in paragraph (a).

Idem.

(2) Any specific programs initiated by the Council in relation to any of the objectives set forth in paragraph (a) of subsection (1) shall, if carried out by the Council, be so carried out only until such programs can effectively be continued by other government departments or agencies.

ORGANIZATION.

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ORGANIZATION.

12. The head office of the Council shall be in the City of Ottawa, but the Council may meet at such other places at such times as it deems necessary.

Head office
and meetings

13. The chairman is the chief executive officer of the Council and has supervision over and direction of the work and staff of the Council.

Direction of
work and
staff

14. (1) The Council may, subject to the approval of the Governor in Council, make by-laws for the regulation of its proceedings and generally for the conduct of its activities, including the establishment of ad hoc, standing and other committees of the Council.

By-laws.

(2) Any by-law made pursuant to subsection (1) establishing an advisory committee of the Council may provide for the membership thereon of persons other than members of the Council, in addition to members of the Council.

Advisory
committees.

15. (1) The Council may

Appointment
of staff.

(a) appoint such officers and employees as are necessary for the proper conduct of the work of the Council; and

(b) prescribe the duties of such officers and employees and, subject to the approval of the Treasury Board, prescribe the conditions of their employment.

(2) The officers and employees of the Council appointed as provided in subsection (1) shall be paid such salaries and expenses as are fixed by the Council with the approval of the Treasury Board.

Salaries and
expenses of
staff

16. The Council may engage on a temporary basis or for any period of not more than two years the services of persons having technical or specialized knowledge of any matter relating to the work of the Council, to advise and assist the Council in the performance of its duties under this Act, and with the approval of the Treasury Board may fix and pay the remuneration of such persons.

Technical
and special
advisers.

17. (1) The Council is for all purposes of this Act an agent of Her Majesty and its powers under this Act may be exercised only as an agent of Her Majesty.

Council
agent of
Her Majesty.

(2) The Council may on behalf of Her Majesty enter into contracts in the name of Her Majesty or in its own name.

Contracts.

(3)

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Economic Council of Canada.

12 ELIZ. II.

Property.

(3) Any property acquired by the Council is the property of Her Majesty and title thereto may be vested in the name of Her Majesty or in the name of the Council.

Proceedings.

(4) Actions, suits or other legal proceedings in respect of any right or obligation acquired or incurred by the Council on behalf of Her Majesty, whether in its name or in the name of Her Majesty, may be brought or taken by or against the Council in the name of the Council in any court that would have jurisdiction if the Council were not an agent of Her Majesty.

Application of
*Public Service
Superannua-
tion Act.*

18. The *Public Service Superannuation Act* does not apply to the members of the Council other than the chairman and the directors, unless in the case of any such member the Governor in Council otherwise directs.

FINANCIAL.

Appropriations.

19. All amounts required for the payment of salaries and other expenses under this Act including expenses of administration shall be paid out of moneys appropriated by Parliament for the purpose.

AUDIT.

Audit.

20. The accounts and financial transactions of the Council shall be audited annually by the Auditor General, and a report of the audit shall be made to the Council and to the Minister.

REPORTS AND PUBLICATIONS.

Annual
report to be
made.

21. (1) The chairman of the Council shall, within three months after the termination of each fiscal year, transmit to the Minister a statement relating to the activities of the Council for that fiscal year, including the financial statements of the Council and the Auditor General's report thereon, and the Minister shall cause such statement to be laid before Parliament within fifteen days after the receipt thereof or, if Parliament is not then sitting, on any of the first fifteen days next thereafter that Parliament is sitting.

Review to be
published.

(2) The Council shall, annually, prepare and cause to be published a review of medium and long term economic prospects and problems.

Other
publications.

(3) The Council may cause to be published such studies and reports prepared for the use of the Council as it sees fit.

REPEAL.

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REPEAL.

22. (1) The *National Productivity Council Act* is repealed. Repeal.
1960-61, c. 4.

(2) Notwithstanding subsection (1), any act or thing required to be done by the National Productivity Council for the purpose of enabling the said Council to give effect to subsection (3) may be done in all respects as though the *National Productivity Council Act* had continued in force.

(3) Forthwith after the coming into force of this Act, any amount standing to the credit of the National Productivity Council after the payment by it of any debts or other obligations thereof shall be paid by the said Council to the Receiver General of Canada to be held and applied towards the payment of the expenses referred to in section 19 as though that amount had been appropriated by Parliament for such purpose.

ROGER DUHAMEL, F.R.S.C.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1963

ANNEX II

MEMBERSHIP OF THE ECONOMIC COUNCIL OF CANADA

MEMBRES DU CONSEIL ECONOMIQUE DU CANADA

Arthur J. R. Smith -- Chairman/ président

David L. McQueen -- Director/directeur

Mr. R. R. Atkinson	President, National Farmers' Union, Saskatoon, Saskatchewan.
Mr. W. J. Bennett	President, Iron Ore Company of Canada, Montreal, Quebec.
Mr. François-E. Cleyn	Président, Cleyn et Tinker Limitée Huntingdon (Québec)
Mr. Robert M. Fowler	President, Canadian Pulp and Paper Association, Montreal, Quebec.
Mr. Arthur R. Gibbons	Executive Secretary, The Canadian Railway Labour Executives Association, Ottawa, Ontario.
Mr. David L. Kirk	Executive Secretary, Canadian Federation of Agriculture, Ottawa, Ontario.
Mr. Walter C. Koerner	Chairman, Rayonier Canada (B. C.) Limited, Vancouver, British Columbia.
Mr. William Ladyman	International Vice-President, International Brotherhood of Electrical Workers, Toronto, Ontario.
Mr. Stanley A. Little	National President, Canadian Union of Public Employees, Ottawa, Ontario.
Mr. Donald MacDonald	President, Canadian Labour Congress, Ottawa, Ontario.
Mr. Ian M. MacKeigan	Partner, Rutledge, MacKeigan, Cox and Downie, Barristers and Solicitors, Halifax, Nova Scotia.
Mr. Maxwell W. Mackenzie	P. O. Box 128, Como, P.Q.

Mr. William Mahoney	National Director for Canada, United Steelworkers of America, Toronto, Ontario.
Mr. Hugh A. Martin	President, Western Construction and Engineering Research Limited, Vancouver, British Columbia.
Mr. J. R. Murray	Managing Director, Hudson's Bay Company, Winnipeg, Manitoba.
M. Marcel Pepin	Président, Confédération des Syndicats nationaux Montréal (Québec)
M. Charles-H. Perrault	Président et gérant général Casavant Frères Limitée St-Hyacinthe (Québec)
Mrs. A. F. W. Plumptre	Immediate Past President, Consumers' Association of Canada, West Hill, Ontario.
M. André Raynauld	Directeur, Département des Sciences économiques, Université de Montréal. Montréal (Québec)
M. Alfred Rouleau	Gérant général et administrateur L'Assurance-Vie Desjardins Lévis (Québec)
Mr. Gabriel Saab	Director, Farm Economics Department, L'Union Catholique des Cultivateurs, Montreal, Quebec.
Mr. William Y. Smith	Head of the Department of Economics and Political Science, University of New Brunswick, Fredericton, New Brunswick.
Mr. Graham Ford Towers	Chairman, Canada Life Assurance Company, Rockcliffe, Ontario.
Mr. William O. Twaits	President, Imperial Oil Limited, Toronto, Ontario.
Mr. Francis G. Winspear	Senior Partner, Winspear, Hamilton, Anderson and Company, Winspear, Higgins, Stevenson and Doane, Edmonton, Alberta.

ANNEX III

PUBLICATIONS OF ECONOMIC COUNCIL OF CANADA

Annual Reviews

- First Annual Review: Economic Goals for Canada to 1970
(EC21-1/1964, \$3.50)
- Second Annual Review: Towards Sustained and Balanced Economic Growth
(EC31-1/1966, \$2.75)
- Third Annual Review: Prices, Productivity and Employment
(EC31-1/1966, \$2.75)
- Fourth Annual Review: The Canadian Economy From the 1960's to the 1970's
(EC31-1/1967, \$2.75)
- Fifth Annual Review: The Challenge of Growth and Change
(EC31-1/1968, \$2.75)

Staff Studies

1. Population and Labour Force Projections to 1970
(EC22-1/1, \$75)
2. Potential Output, 1946 to 1970
(EC22-1/2, \$1.00)
3. An Analysis of Post-War Unemployment
(EC22-1/3, \$75)
4. Housing Demand to 1970
(EC22-1/4, \$75)
5. Business Investment to 1970
(EC22-1/5, \$1.00)
6. Special Survey of Longer Range Investment Outlook and Planning in Business
(EC22-1/6, \$2.50)

PUBLICATIONS DU CONSEIL ÉCONOMIQUE DU CANADA

Exposés annuels

- Premier exposé annuel: Objectifs économiques du Canada pour 1970
(EC31-1/1964F, \$3.50)
- Deuxième exposé annuel: Vers une croissance économique équilibrée et soutenue
(EC31-1/1966F, \$2.75)
- Troisième exposé annuel: Les prix, la productivité et l'emploi
(EC31-1/1966F, \$2.75)
- Quatrième exposé annuel: L'économie canadienne des années 1960 aux années 1970
(EC31-1/1967F, \$2.75)
- Cinquième exposé annuel: Défi posé par la croissance et le changement
(EC31-1/1968F, \$2.75)

Études préparées par le personnel

1. Projections de la population et de la main-d'œuvre jusqu'à 1970
(EC22-1/1F, \$75)
2. Potentiel de production, 1946 à 1970
(EC22-1/2F, \$1.00)
3. Une analyse du chômage depuis la fin de la guerre
(EC22-1/3F, \$75)
4. Demande d'habitations pour 1970
(EC22-1/4F, \$75)
5. Investissements privés pour 1970
(EC22-1/5F, \$1.00)
6. Enquête spéciale sur les intentions et la programmation à moyen terme des entreprises privées
(EC22-1/6F, \$2.50)

Author—Auteur

Council—Conseil

Council—Conseil

Council—Conseil

Council—Conseil

Council—Conseil

F. T. Denton

Y. Kasahara S. Ostry

B. J. Drabble

F. T. Denton

S. Ostry

W. M. Illing

D. A. White

B. A. Keys

Staff Studies (continued)

7. Canada and World Trade
(EC22-1/7, \$50)
8. Export Projections to 1970
(EC22-1/8, \$75)
9. Federal Tax Revenues at Potential Output, 1960 and 1970
(EC22-1/9, \$50)
10. National Saving at Potential Output to 1970
(EC22-1/10, \$50)
11. Changes in Agriculture to 1970
(EC22-1/11, \$50)
12. The Contribution of Education to Economic Growth
(EC22-1/12, \$100)
13. Internal Migration in Canada, 1921-1961
(EC22-1/13, \$100)
14. Interregional Disparities in Income
(EC22-1/14, \$175)
15. An Analysis of Interregional Differences in Manpower Utilization and Earnings
(EC22-1/15, \$100)
17. Business Cycles in Canada
(EC22-1/17, \$225)
18. Manpower Planning in Industry: A Case Study
(EC22-1/18, \$100)
19. Population, Family, Household and Labour Force Growth to 1980
(EC22-1/19, \$100)
20. Enrolment in Schools and Universities, 1951-52 to 1975-76
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F. Wildgen

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B. A. Keys

H. H. Wright

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Canada
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First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

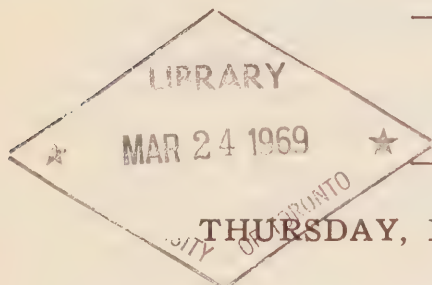
SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

The Honourable DONALD CAMERON, *Vice-Chairman*



No. 26

THURSDAY, FEBRUARY 6th, 1969

WITNESSES:

Treasury Board: S. Simon Reisman, Secretary; James Lawrence Fry, Director of Program Division responsible for Economic Measures and Scientific Research.

APPENDIX:

27.—Brief submitted by Treasury Board.

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Grosart	Nichol
Belisle	Haig	O'Leary (<i>Carleton</i>)
Blois	Hays	Phillips (<i>Prince</i>)
Bourget	Kinnear	Robichaud
Cameron	Lamontagne	Sullivan
Carter	Lang	Thompson
Desruisseaux	Leonard	Yuzyk
Giguère	McGrand	

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th 1969:

With leave of the Senate,

The Honourable Senator MacDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

Thursday, February 6th 1969

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Blois, Bourget, Cameron, Giguère, Grosart, Haig, Kinnear, Lang, Leonard, Nichol, Robichaud, Sullivan and Yuzyk – 14.

In Attendance:

Philip J. Pocock, Director of Research
(*Physical Science*).

The following witnesses were heard:

TREASURY BOARD

S. Simon Reisman, Secretary; and
James Lawrence Fry, Director of Program Division responsible for Economic Measures and Scientific Research.

In Attendance:

Sylvain Cloutier, Assistant Secretary; and
Bruce A. MacDonald, Director, Planning and Analysis Division, Program Branch.

(A curriculum vitae of each witness follows these Minutes).

The following is printed as Appendix No. 27:

Brief submitted by Treasury Board.

At 12.30 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

REISMAN, S. SIMON Mr. Reisman was born in Montreal, Quebec. He received a B. A. in Honours Economics and Political Science from McGill University and an M.A. from the same university in 1942. In 1945, he attended the London School of Economics. In 1942, he joined the Canadian Army and served overseas with the Royal Canadian Artillery. He returned to Canada in 1946 and joined the Civil Service with the Department of Labour. He transferred to the Department of Finance that year and in 1954 was appointed Director of the International Economic Relations Division. From 1955 to 1957, he was Assistant Director of Research on the Royal Commission on Canadian Economic Prospects. Mr. Reisman is the author of "Canada-United States Economic Relations" which was prepared for the Commission in 1957. In 1957, Mr. Reisman was appointed General Director of Economic and International Affairs in the Department of Finance. In 1961, he was named Assistant Deputy Minister for Economic Affairs, Industry, Tariffs and Trade in that department. In July 1964, Mr. Reisman was appointed Deputy Minister of the Department of Industry. Since 1947, Mr. Reisman has served as a Canadian delegate in various international economic, tariff and trade conferences and has also participated as a negotiator for Canada in numerous trade agreements, including the Canada-U.S. Automotive Agreement and the recently concluded Kennedy Round of tariff negotiations at Geneva. In April 1968, Mr. Reisman was appointed Secretary of the Treasury Board.

FRY, JAMES LAWRENCE *Place of Birth:* Hartney, Manitoba *Date of Birth:* July 6, 1927 *Education:* High School – Hartney, Manitoba University of Manitoba – B.A. 1948 University of Toronto – M.A. 1950 Political Science *Employment History:* Joined the Federal Government in 1950 as a Junior Administrative Officer, assigned to the Department of Finance, Comptroller of the Treasury. Held various posts in this Organization finishing in the fall of 1956 as Establishments Officer for the Comptroller of the Treasury Organization. Fall of 1956 joined Treasury Board as a Group Chief and have been employed by Treasury Board since that time, becoming a Director of the Program Analysis Branch early in the 1960's. At present, Director of the Program Analysis Division responsible for Economic Measures and Scientific Research Departments.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Thursday, February 6, 1969.

The Special Committee of the Senate on Science Policy met this day at 10.00 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, this morning we have the pleasure of receiving a representation from the Treasury Board. To my right is Mr. Simon Reisman, Secretary of the Treasury Board, and on his right is M. Sylvain Cloutier, qui est secrétaire adjoint du Conseil du Trésor.

They are accompanied by Mr. Bruce A. MacDonald, Director of the Planning and Analysis Division, Program Branch, and Mr. James Lawrence Fry, Director of the Program Division responsible for Economic Measures and Scientific Research.

I do not need to tell you, Mr. Reisman, that your contribution to the work of this committee was expected, and has been desired for a long time. Of all the agencies that have been talked about in this committee yours has been referred to the greatest number of times. We have not felt that you were entirely absent because we were told that some of your people were following our deliberations very faithfully, and because of that fact I am sure you are not here this morning unprepared.

On behalf of the committee I assure you that you and your colleagues are most welcome. As others have done, perhaps you want to make some kind of an opening statement; if not, we will proceed immediately to the discussion.

Mr. Simon Reisman, Secretary, Treasury Board: Merci beaucoup, monsieur le président. Honourable senators I am really in your hands . . .

The Chairman: Do not say that at the beginning.

Mr. Reisman: I am afraid I am. We have submitted a brief. I do have a prepared statement which I can read if it is your wish to hear it. For me, at least, this would be an easier way of getting into the dis-

cussion and relaxing a bit before I am confronted by all the fiery questions that no doubt will arise.

Let me say at the outset that we have been looking forward to appearing before you, partly because it will give us an opportunity to allay some of the misconceptions, perhaps, about the Treasury Board and what it does. The vitality of this committee, and the range of witnesses it has already heard from all over the world, has given it a very high reputation, and the quality of the discussion up to this point makes it an honour and a privilege for anyone to appear before it.

With your permission I should like to read this statement. It is not a long statement, and we do have copies which we can distribute afterwards if anybody cares to refer back to it and question us on it.

Last month we submitted a brief to your committee dealing with the Treasury Board's organization, its general functions and the relationship of the Board to other government bodies. Also included in the brief is a description of the mechanism by which the Board reaches decisions on the allocation of resources over the whole range of federal expenditures. Today, with your permission, I should like to say a little more about the thinking that lies behind the decision-making process when resources are allocated between competing demands.

The planning and control of government expenditures is, of course, a very old problem, as old as governments themselves. For as long as there have been governments there has been the problem of what governments will do and what will be left to the private sector to do. This process is particularly complex in a democratic society such as ours where many and varied points of view must be taken into account in deciding what to do and who gets what.

When we talk of the planning and control of government expenditures, we are, of course, talking about a process in which politicians and not public servants are at the centre.

The Chairman: Quite an admission.

Mr. Reisman: Perhaps I may divert from my text for just one moment to say that in tabling the Estimates the day before yesterday, I think that my minister, the Honourable C.M. Drury, in his statement made a reference to the fact that something like 82 per cent of the increase in expenditures was accounted for by programs that had been authorized by Parliament. That means the area where the Executive had some discretion in respect of the increase in expenditures was a mere 18 per cent. This really means that if that is any indication of the relative proportion, then it is Parliament essentially.

The Chairman: Parliament is at the end, not at the centre.

Mr. Reisman: Well, these particular statutes were approved by Parliament; they were Parliamentary statutes.

Senator Sullivan: From the Treasury Board.

Mr. Reisman: Presumably Parliament could have denied them if they wished to do so.

Quite obviously in a democratic system the real choice and the real control lie with government, Parliament and the people. The inherent complexity of decision-making in a democratic society becomes more intense as our world becomes more complex and as governments take on a larger role in meeting the needs of their citizenry. This in turn has imposed the need for more solid information and better methods to assist the people whom we have charged with the responsibility of making decisions.

Before turning to the more specific aspects of the Treasury Board's work, I should like to make one basic, fundamental point about expenditures control. It is universally true for all governments and at all times that we cannot afford to do all the things that we may wish to do or are being urged to do. There simply is neither the money nor the human resources required to do, at the same time, all the worth-while things, regardless of how desirable they may be. This means that choices have to be made. Some things must be put off for a later date. This, of course, is all that is meant by priorities and planning.

In the procedure for resource allocation, as you know, the starting point for each department in obtaining resources for its programs is the preparation each year of a five-year forecast of its plans, highlighting the financial and personnel resources required to carry out those plans. This practice, introduced only a few years ago, is known technically as the Program Forecast Submission. In preparing the Program Forecast in the spring, each department is, of course, faced with the need to make choices between many desirable projects. Central to this

whole process of making specific choices is the prior formulation by the Cabinet of a set of expenditure guidelines. While these guidelines are, by their very nature, quite general, they are the product of careful consideration by ministers in the light of the best information and analysis that can be provided on the economic, political and social issues facing the nation. Not least important in this process of establishing guidelines is a careful appraisal of the state of the economy and of the financial resources that are or can be made available. Technical and expert staff support which may be required by ministers in drawing up the guidelines is provided by the Department of Finance, the Treasury Board Secretariat and the staff of the Privy Council Office, each providing advice and information in its respective field of expertise.

While each department reflects the Cabinet expenditure guidelines in its own programs as presented in its Program Forecast Submission, it is inevitable that an overall view has to be taken of the total package of Program Forecast Submissions, because we always have more claims on resources than there are resources available to pay for them.

If I may be permitted to divert here for a moment, my recollection is that for the fiscal year 1969-70, for which Estimates have just been tabled, the original Program Forecast Submissions would have involved expenditures something like \$1 billion higher than was actually tabled, so that somewhere in the process somebody, some group of people, had to shave those proposals by as much as \$1 billion to get to the figure the Government decided to table before Parliament.

The Chairman: This was in spite of the guidelines?

Mr. Reisman: This was in spite of the guidelines, yes. I use the figure \$1 billion. I may be a little out. It may have been \$1-1/4 billion, because when you begin to pull together all the things that all the departments and agencies want to do you have to think in terms of scores of millions and not in terms of thousands or single millions. There is really that much demand being placed on the resources that may be or may become available.

There is also, of course, the continuing need to examine programs to insure that they are carried on efficiently. The Treasury Board Secretariat examines the total group of Program Forecast Submissions against the guidelines and the resources available for the coming year. This examination yields, after detailed discussions with the departments, a set of departmental expenditures and manpower targets for consideration by the Treasury Board itself and by the Cabinet.

I might say here that in using terms like "detailed discussions" and "consultations" I am using

euphemisms. Hard negotiations take place, and very often you get eyeball to eyeball confrontations about this or that element. It is to be expected that that should be the process, because the departments and agencies who are submitting their proposals are very enthusiastic about them; they would not have submitted them if they did not feel they were vital and desirable, and indeed often necessary, so you do get a very vigorous exchange of views about them when you have to fit them in within a total framework.

Through this process departments receive approval in principle of their plans for the ensuing year, as they may have been modified by the Treasury Board and by the Cabinet. Departments can then proceed with more precise budget estimating and planning, on the assumption that their estimates will probably be favourably received so long as they do not exceed the targets. The product of all this effort is the estimates submission to Treasury Board by each department setting forth the detailed expenditures for which they propose to seek parliamentary approval.

I have described the broad framework in which resource allocation decisions are taken. I expect I have aroused your curiosity on what goes behind the scenes when the Board Secretariat and individual departments and agencies meet to hammer out expenditure targets before ministers get to see them. And what do ministers really do when the material gets to them?

I am sure that Honourable Senators will appreciate that neither the Treasury Board nor its secretariat has a magic formula for reaching budgetary decisions. As you can see from looking at the people at this table—with the exception of the chairman—and at the members of the Treasury Board staff who are seated on my right, none of us has really been touched by the hand of God; we are pretty ordinary people—

A member: Except the minister.

Mr. Reisman: We have the same kind of problems as anyone else and we do not have any ouija boards or any magic implements of any kind to enable us to do this better than any other people. It may be that we have had some more experience with these matters.

The Chairman: Obviously, Mr. Reisman is preparing to go to the Department of External Affairs.

Mr. Reisman: As a matter of fact, I would like to.

The role of the Treasury Board and its Secretariat is one of rationalizing the requirements of all departments and agencies and fitting them into a national budgetary picture. The burden of determining priori-

ties at the planning stage rests primarily with the individual departments. It is essential that the proponents of expenditure programs be called upon to explain the purpose of their proposals—their objectives, the costs, the potential benefits—and that, at the same time, consideration be given to other programs that may go unsatisfied as a result of supporting the one in question. It is the job of the Board to fit all these requests into a framework set by the total resources available and the guidelines established by the Cabinet. And this process, of course, involves some cutting and some trimming—and I see that someone on my staff has cut out another word which I put in, that is, some bloodletting.

And so budgeting at the national level becomes an exercise in rationing the available resources among competing claims. If you ask me how this rationing is actually accomplished, I can only say that it is the product of a wide range of information, counsel, analysis and other considerations.

I am sure that everyone would like to have a foolproof method of allocating resources—one that will measure systematically the national benefits that we are expected to accrue from given national investments. We do not have such a foolproof system in Canada nor, as far as I am aware, does anyone else in the world, whereby this kind of comparison between benefits and costs can be made with precision and certainty. I venture to say that we will never have a foolproof system for making choices and setting priorities. But better systems are being developed in Canada and elsewhere and we are improving our capabilities to do this work. I will be saying a little more about this later under the heading "Planning, Programming and Budgeting".

Up to this point, I have been talking about expenditures generally and have made no special reference to scientific and technological programs as such. Since your committee is particularly interested in expenditures of this nature, I would like to say a few words on this subject at this point.

This committee has received expert witnesses from many departments and agencies in Government as well as from universities and other institutions. You have also received evidence from renowned scientists from the United States and overseas countries. You have had wide-ranging submissions about many scientific and technological programs performed by governmental agencies or financed by government. I am not a scientist and do not intend to compete with your other witnesses in this sector of expertise. I would, however, like to say a few words about scientific and technological activity as seen from the vantage point of the Treasury Board staff.

In the eyes of the Board, science is not regarded as a thing in itself but rather as a means to an end. In general, particular scientific projects are not exam-

ined on their own merits but rather as components of programs which have defined objectives. Let us take, for example, the scientific and technological projects of the Department of Industry. One of the principal programs of that department is the efficient expansion of Canadian secondary industry. There are many tools to achieve the objective of this program of which science and technology are among the most important. From the point of view of Treasury Board, the claim for resources by the Department of Industry to further its industrial development objective must be justified in terms of that program, and not in terms of the various instruments, or tools or methods, that may be available to it to help it achieve the objectives of that program. If we assume that the Cabinet expenditure guidelines place a high priority on programs for industrial expansion, resources will be allocated to the Department for this purpose. It is then for the Department itself to determine the mix of instruments and measures to achieve its goals. These will include financial assistance to industry, commercial policy, export promotion and assistance and also a substantial component of aid to industry to help it develop its scientific and technological capability. I can cite similar examples for other departments and agencies which carry on extensive projects in the field of science and technology in order to further their program objectives. These include—to mention a few—Atomic Energy of Canada Limited, the new combined Department of Fisheries and Forestry, the Department of Energy, Mines and Resources, the Department of National Health and Welfare, the Defence Research Board, the National Research Council, and the new Department of Communications. Those are some of the departments that are mission oriented, that have very extensive scientific and technological projects and activities which have to be viewed within the framework of the programs that they have been allocated; or within the framework of the statutes or the other directives pertaining to them.

The Board in its current work on expenditure proposals is operating within the framework of governmental policy which views science and technology as essential ingredients in an advancing economy. From our readings and from our observations and from the guidelines which have been put to us for examining programs, it is quite clear that this Government—and, indeed, every preceding government for whom I have worked—have felt that a reasonable amount of basic research warrants national support as a means of creating new knowledge, building a core of scientifically motivated personnel and preserving a scientific awareness throughout the country. There is also a broad view—you can almost call it a national policy—about science and scientific activities, that there is a need for expanding applied research directed to solving problems of national concern in the economic, social, and cultural fields.

Coupled with these two forms of research is the need for a balanced program of industrial development and technological innovation. Certainly, industrial technology and innovation are considered by most contemporary economists to be key factors in economic growth. Servan-Schreiber, in his recent book—which I am sure you have all read—entitled *Le défi américain*, observes that economic development in this decade appears to be more dependent upon the education of a nation's human resources and industrial technological innovation than it is upon traditional increases in labour forces and invested capital. The Government's role in encouraging the appropriate climate for industrial development and innovation is consequently a consideration of prime importance in allocating federal resources to national research and development activity.

This kind of thinking enabled the Treasury Board to identify, within the framework of the Cabinet's expenditure guidelines, selected areas of broad research and development activity that justified priority treatment. For example, in an endeavour to encourage greater support of medical, scientific and engineering research performed in non-government facilities, increases were authorized for grants in aid of such research activity in 1968-69 departmental Estimates. And if I am not mistaken, there were increases again in the 1969-70 Estimates for these same purposes. At the same time, the Government allowed for research increases in certain natural resource areas such as water because of the need to increase efforts in water pollution control. Finally, in recognition of the importance of industrial research and development, the Government provided for increases in a number of Department of Industry and National Research Council programs, which were directly related to the level of activity of scientific work in industry itself.

Priority for certain expenditures is, of course, made possible by a highly selective attitude in other fields of proposed expenditure. Because of current financial constraints and also because statutory and other commitments account for about 40 per cent of annual expenditures, there is limited room for manoeuvre. May I just interrupt here to say that in the copy of this statement which has been circulated the figure of 40 per cent appears as the measure of the statutory commitments. I think that the correct figure, if we look at the changes that have occurred in the past several years, should be 48 per cent. It is roughly half now. Forty-eight per cent are committed by statute and the other 52, presumably, lend themselves to some kind of executive control. But you will appreciate that with on-going activities the degree of executive control that there is, even with respect to the 52 per cent, is really not all that broad. There is a narrow range where you have some discretion and control and can have some influence

in the short term on changes and expenditure levels. As a result, new programs or major increases in existing programs can usually be adopted only by finding total or partial offsets elsewhere in the budgetary base. In the case of this year's research and development programs, the Government found it necessary to defer or reject a number of proposed research projects of a capital nature as well as hold the line on proposed growth in other departmental research and development activity to provide the increased funds in the priority research and development areas. I am sure that in the question period you may be interested in learning a little more about some of those areas.

There are certain research and development projects or proposals that are of such magnitude in terms of financial and manpower investment and which potentially have so great an impact on the scientific community and the economy generally that they require their own individual assessment. These projects cannot, in our judgment, be handled as just another item or research and development expenditure within a departmental budget. They become the subject of special study and analysis and are, whenever feasible, referred to independent parties for objective review, usually including, of course, the Science Secretariat and, where appropriate, the Science Council.

Such was the case with the project known as TRIUMF—Tri-University Meson Facility—which represents a major new development in accelerator technology by the three west coast universities of British Columbia, Simon Fraser and Victoria, and recently also in co-operation with the University of Alberta. This proposal will cost in the order of \$25 million over seven years and will be a co-operative financial undertaking between the Federal Government and the universities. Prior to being approved earlier this year for federal support, the proposal was carefully reviewed by the Atomic Energy Control Board with the help and advice of independent consultants and the Science Secretariat. We have people here from the Science Secretariat. I hope I am correct in that statement.

The record indicates that the Federal Government is playing a large and expanding role in the financial support of Canadian research and development activity. As Appendix "D" of my brief to your committee indicates, federally-supported research and development has more than doubled in the past five years. The Federal Government has targeted to spend about \$520 million on scientific research and development during the current fiscal year representing approximately 50 per cent of all research and development expenditures that will be made in Canada during that period. This value covers the support of research and development—both civil and defence—

performed in industry, universities and Government departments, grants in aid of research and development and of capital expenditures for research and development purposes. It excludes Government expenditures on certain related activities such as scientific data collection and information services. Just digressing here for a moment, I imagine also, and Mr. Cloutier will correct me if I am wrong, that not included in this figure would be the massive federal support for post-secondary education. I suppose that the federal support comes to about half of the total operation expenditures. A good deal of those expenditures would be in universities, both undergraduate and graduate, and that would not turn up in these figures.

The Chairman: Would this figure include the social sciences?

Mr. Reisman: No, this figure does not include the social sciences.

While the federal Government has been actively supporting Canadian scientific effort, we do not know whether the total help has been enough. Nor do we know how much more effective the expenditures might have been had we had a better means of relating the application of the research and development effort to nationally defined goals and priorities. This brings me to the future.

I would now like to deal with the Treasury Board's plans for strengthening decision-making with respect to national expenditures.

Our main effort to this end is the installation of the planning, programming and budgeting system. While I would not want to suggest that it will be the cure for all resource allocation problems, it should improve the Government's ability to reach better solutions to budgetary problems and to react systematically to changing environmental needs. In addition, it should provide Government with more knowledge and insight which should help it to establish its goals in a more systematic manner.

What is planning, programming and budgeting specifically? What are its origins, its principal concepts, its application to the Canadian scene? The booklet entitled "Planning, Programming and Budgeting Guide", reproduced in my brief, tells much of the story. I would, nevertheless, like to run through the main points of PPB as I see them.

Credit for PPB goes to the United States. It had its origins in work done by a number of U.S. companies, including the Rand Corporation, and was further developed and perfected by the Department of Defense in handling its defence budgeting activities. In Canada, Treasury Board first got actively interested in PPB in 1965 and has been planning its introduction since that time. Perhaps the words "planning its introduction" understates the range of

progress already made. Departments have been working with this system for quite a little while now and the five-year program is part of it. Any cost-benefit analysis they do is part of it. The setting up within the departments of small sections doing program evaluation and review is all part of it. I would not want to understate the degree to which we have already progressed in moving into that system.

There are three key aspects to PPB. The first is the importance of having clear objectives for each department and agency which, in turn, are derived from national goals.

The second feature is that PPB adds the dimension of cost-benefit analysis to the control of Government expenditure; that is, the anticipated benefits must be systematically compared with the costs.

The third element of PPB is the need to examine the alternative means of accomplishing defined objectives.

PPB is intended to serve as a management tool for both Parliament and the executive in carrying out their respective responsibilities relative to public expenditures. PPB should enable parliamentarians to get a picture of expenditure proposals against particular departmental objectives. This will be possible because the Government's annual Estimates will include a statement of the objectives of departmental programs and a description of the activities in each program. Expenditures by program and activity will be shown in one section of the Estimates Book by department and in another according to broad functional categories such as economic development and health and welfare measures. Accordingly, all activities related to a particular category of Government expenditures will be drawn together, regardless of the fact that these activities may be carried on by two or more departments and agencies. In this manner, parliamentarians and the public will be able to see at a glance total federal expenditures related to a particular function such as economic development.

The Chairman: If I may interrupt you, for a moment, Mr. Reisman, will there be a special figure, for instance, for expenditures devoted to R and D in scientific activities?

Mr. Reisman: The answer to that is no. Let me take a moment to explain. This is really a fundamental question and it goes to the heart of what we are doing. There is really a sharp difference between the way we look at it and the way some experts look at it inasmuch as they want to lump together all those things that can be called R and D. We no more lump together R and D into one piece than we would lump together all those expenditures related to historical analysis. Historical analysis is after all a device for learning about problems in the world about us

and which helps us and guides us in solving problems. We look at science as an instrument, a method of approach, and we believe that to every good program every well ordered institution should devote a great deal of time, resources, energy and personnel to doing organized scientific research and development work. If they don't do that, it won't be very good for very long. But the notion that it should all be lumped together and that there is necessarily a relationship between all the bits of science is something foreign to our way of thinking.

The Chairman: Thank you.

Senator Grosart: Could I make the comment at this point that in spite of the statement you have made in your brief "while no one has yet succeeded in formulating a general theory relating investment in science to economic progress" you say an awareness of this apparent relationship, a relationship of the total bundle which you are now rejecting has influenced the Government in regard to science. The question I hope to come to later is: If this is so important are you doing something about it in spite of the statement? Are you doing something to decide what is the relationship of the total bundle of R and D expenditures to national productivity in Canada?

The Chairman: Senator Grosart, I think we should reserve these questions for the discussion period. My question was for information only because you had used another example like economic development.

Senator Grosart: My question was for information too, Mr. Chairman.

The Chairman: It was a little argumentative too.

Mr. Reisman: I will abide by the chairman's ruling but I will make a note of it and will direct myself to it specifically and directly when we get into the next phase.

It is hoped that a clear statement of program objectives and the grouping of expenditures by program and Government functions will be included in a new form of Estimates commencing with 1970-71 expenditures. As with the introduction of the five-year program forecast, a few years ago, this new form of Estimates will constitute another major step in the PPB process. But even then, more steps will have to follow if PPB is to evolve in its intended form. We will have to exercise care to ensure that what purport to be statements of objectives are not merely the laudatory description of ongoing activities and current practices. We will also have to give much more study to the identification and analysis of alternatives courses of action which may be considered in meeting departmental objectives, as well as to the measurement of results. In time parliamentarians should have not only a picture of proposed spending against particular objectives, but also information

about alternative investment choices and the benefits therefrom.

One may summarize the purpose of the PPB system as that of ensuring that the raw material required for national decision-making and resource allocation—clear objectives, cost-benefit analysis and alternative courses of action—is available to the Board, to the Cabinet, and to Parliament, which are faced, each in its own sphere of responsibility, with the task of making such policy judgments and choices.

Mr. Chairman, perhaps this is enough by way of formal introduction. I would be pleased to attempt to answer any questions which honourable senators may have.

I have not stayed as close to my text as perhaps I should have, but I do hope I have provided some kind of a basis in this introductory statement for many good questions which my staff and I will attempt to answer to the best of our ability.

The Chairman: Thank you very much, Mr. Reisman. I am sure we will have a long discussion period and I hope it will also be interesting.

Now in spite of his many problems today including that of moving from one office to another, Senator Robichaud will initiate the discussion.

Senator Robichaud: Thank you, Mr. Chairman.

In initiating the discussion or the questions today I am placing myself, maybe, in a different position than that in which I was when associated with the Treasury Board for a period of five years. As a member of the Treasury Board and as one of the members of the Cabinet, I have had some experience with the Board. I had the pleasure of attending most of the meetings of the Board for a period of five years, and I hope that in my brief remarks and my questioning this morning I will not forget that I did once take an oath of office, and as I have the initials "P.C." after my name, I am one of those who believe that it should be respected.

The Chairman: Are there others who do not?

Senator Robichaud: No comment!

The brief which was presented to us a few days ago gave a good description or outline of the organization and functions of the Treasury Board, and I am sure that the members of this committee will agree that the presentation by Mr. Reisman this morning has certainly added more light to the procedure which is being followed by the Board in reaching its decisions.

Senator Grosart: I was wondering if you recognized it.

Senator Robichaud: Definitely.

There is no doubt that there are some misconceptions as to what the Treasury Board is all about. Rightly or wrongly, the Treasury Board is quite often being tagged or blamed as being mainly responsible for decisions affecting, one way or another, programs introduced by different governments or agencies.

The Chairman: Did you say "wrongly"?

Senator Robichaud: Wrongly or rightly—I am not making the decision on this.

However, I would ask Mr. Reisman if he could elaborate as to who decides, say, for example, what R and D projects within a department or a Government agency must have priority, and what means are taken by the Board of getting enough information together to arrive at their decision.

Mr. Reisman: Senator Robichaud, this is a very central question. I tried to say a little about that in the brief and also in the oral presentation, but obviously a little articulation and filling out might be helpful.

Senator Robichaud: May I give as an example, say we take programs to be introduced by the Department of Agriculture. I think we have been led to believe that the priority of such programs depends on the decision of the Treasury Board.

Mr. Reisman: The first and most important instrumentality in the selection of programs and projects is the department itself—the department, of course, consisting of a minister who presides over it and the entire staff of that department.

If we are talking about a program which is planned and proposed, but not yet in being, the system will be something as follows. The minister and his deputy minister and senior staff will, in the course of discussions and deliberations, decide it is desirable to proceed in a particular direction. It may be in the field of science; it may be in the field of income and price support; or it may be in the field of marketing. It may be in any one of a variety of fields for which they in the Department of Agriculture have responsibility.

Having launched an idea, they will then get their staff to do investigations and research and put together a proposal which meets the broad lines and the wishes of the minister and, presumably, reflecting the wishes of his Department's "constituents" of the country. Once that proposal is put together in the best form that that department knows how, if the department is a wise one it will have discussions with several of the central agencies. The deputy minister of that department will probably wish to have a discussion

with the Deputy Minister of Finance and also with the Secretary of the Treasury Board. He will fill them in and tell them what this proposal is all about, why it is being put forward, what kind of financial, manpower and other resources will be required for it. In the ordinary course of events, a certain amount of discussion and perhaps even negotiation will take place at that level.

The Deputy Minister of Agriculture, in that case, knowing the wishes of his minister, will know how far he can go in his negotiations and consultations, but some of the observations, in this case by Finance and the Treasury Board, may be worthy of consideration and may find their way into a revised proposal.

That proposal will then be put by the Minister of Agriculture to the Cabinet for consideration. The Privy Council Office, when it gets that proposal, will examine it and will say, "Well, this looks like a proposal which is essentially one in the field of economic policy. We will send it to the Cabinet Committee on Economic Policy and Programs, and that committee will examine it." This provides the first major opportunity for a group of cabinet ministers to examine the proposal. Each minister represented on that Cabinet Committee will, if he is very interested in this, seek advice from his own senior officials on what this proposal is about and what view he might wish to take on it. They will have discussions, and these may be reflected in the deliberations that take place in the Cabinet Committee.

That committee will then come up with a recommendation. The recommendation could be one of many. It could be a recommendation to have the proposal referred back and improved, or it could be a recommendation that the proposal is of such worth that it should immediately go before the full Cabinet for consideration, or it may have a combination of elements in it.

On the assumption it is a proposal that has a great deal of merit, and has already received careful consideration and examination by all agencies and departments having an interest in it, it goes to the Cabinet, and Cabinet decides whether it wishes to proceed or not.

If it wishes to proceed, it may want to proceed by way of legislation, when it is of that order of magnitude. Or, if it is within the framework of executive authority, it may decide to authorize the Minister of Agriculture to proceed with it.

In examining it in cabinet committee, and in Cabinet, there will be consideration given to not only its immediate cost but its cost over the long term, and the kind of resources that are required. All of these factors will be taken into account in deciding whether or not to proceed with it.

That is the kind of process that takes place with respect to a new program, or the significant alteration of an existing program. You will observe that Treasury Board as such has very little to do with that proposal as it moved from its formulation stage in the department up the decision-making process. I did observe that the staff of the Treasury Board were involved in the early phases of formulation and consultation, and I should observe also that the President of the Treasury Board, and individual members of the Cabinet who sit on the Treasury Board, will all certainly be involved when the subject comes before the full Cabinet. But, the Treasury Board as such, as a board of ministers, will not have been involved directly.

Perhaps you will permit me to make an observation here, sir. It has taken me a little time to appreciate this. I am relatively new to the Treasury Board. I have been on the Board's staff for ten or eleven months now, and it has been of great interest to me to try to form some kind of an evaluation of just what is the heart and soul of the Treasury Board's work. I have come to this conclusion, that the Treasury Board is not a policy-making body in the broad sense of the word "policy". It is very much concerned with administrative policy and management policy, but not with policy in the sense that we are using it here when we talk about decisions on new programs, new activities, and major revisions of on-going activities.

I would liken the Board to the general manager of a corporation in which the policy is decided by the executive—by an executive board—and where the general manager executes it, and is concerned with the effectiveness of the action and the efficiency with which it is conducted. Within the framework of government, which is such a complicated and large apparatus, perhaps one should liken the task of the Treasury Board to that of a general manager of an industrial conglomerate where you have a whole series of more or less independent firms, and where you have an executive board sitting over the whole system, as well as a general manager for the conglomerate who presides over the broad management decisions but who does not in fact operate as a general manager of an individual firm or company. The individual firms or companies would be comparable to the departments or agencies of government.

This has been a long answer, sir. I could go on and talk about what happens in respect of programs that are not of such an order of importance that the department feels it necessary to take them to the cabinet, but wants to handle them within its own rather narrower framework. Perhaps I had better wait a bit.

Senator Robichaud: My second question is exactly in that field. I would like to refer to page 2 of your

brief where you deal with the organization of the Treasury Board and its relationship to other government bodies. You say:

In broad terms the Treasury Board staff is responsible for surveillance, investigation, co-ordination, negotiation and advice in regard to the matters within the board's jurisdiction, but the power of decision remains unequivocally with the Ministers.

I should like to ask you what criteria the board's secretariat uses, or how does the board decide which projects or which matters are not within the secretariat's jurisdiction and must be submitted to the cabinet ministers?

Mr. Reisman: This is a very tough question. You are asking me of the many matters that come before the Board. . .

Senator Robichaud: Where is the division line?

Mr. Reisman: What the Board Secretariat handles is pretty well routine. You are asking how they decide what they put before the Board?

Senator Robichaud: Yes.

Mr. Reisman: There is no magic formula even there. It is a matter of judgment. Perhaps I should indicate to senators how this system has been progressing over a period of time.

I am told by my predecessors in the office of Secretary of the Treasury Board that as recently as ten years ago something like 20,000 cases a year were actually put before the Board. Obviously, if a board consisting of ministers is to look at 20,000 cases they are going to have to spend an awful lot of time on them, and, further, they are not going to be looking at each individual case in a minute manner. That is just not physically possible. Over the years since that time efforts have been made to reduce the work burden of the Treasury Board in respect to this whole range of administrative and managerial type of decisions by way of delegating as much of these as can be delegated within the framework of the law to the departments and agencies themselves. So, within a department the management of the department would be responsible for those decisions, and have the responsibility for being wrong or right. Gradually, over a period of time, the number of cases that are actually sent to the Board has been reduced very considerably.

As this system of delegation progressed another device was introduced, the device of vetting the submissions that are made to the Board by way of putting into one pile those that seem to be of a routine or minor nature, and those that would require the

judgment and decision of ministers. In order to make sure that ministers would have an opportunity of looking at them all, the routine cases were assembled in a book which was placed in the centre of the table at the Treasury Board meetings so that the members of the Board—the ministers—would have an opportunity of leafing through it and raising questions about any one of the cases that attracted their attention.

The Chairman: It was only theoretical.

Mr. Reisman: I myself have not been in the position where ministers questioned matters that had been put on the table as routine, but I am told that in the past it was not at all uncommon. I am told by my predecessors—you know, there are quite a few of my predecessors still around, and alive and kicking, although sometimes I wonder how and why. George Davidson, Ernie Steele, Bob Bryce, and John Deutsch are still around, and I sometimes like to compare notes with them and ask them how they did their work, and discuss with them the kind of problems they ran into. They have told me that every now and then an enthusiastic member of the Treasury Board would leaf through this book and come upon a case that seemed to be interesting, and would raise quite a lot of questions about it.

Over the years—and I think you are right, Mr. Chairman—it got to the point where ministers, because they developed confidence in the staff who were presenting these matters, I suppose, and also because they had a lot of very heavy and important business of a kind that ministers are concerned with and interested in, did not get too worried about the routine cases.

Perhaps by way of elaboration I should select an example of how the process works. It is an interesting example, and I do not think I would be revealing confidences of a kind that it would not be appropriate for me to reveal. Again it concerns the Department of Agriculture.

Senator Robichaud: You could mention ING.

Mr. Reisman: We could go to that too.

The Chairman: Or the Department of Fisheries.

Mr. Reisman: We have examples there too.

Senator Robichaud: And real ones.

Mr. Reisman: In this particular fiscal year, after we had completed our exercise of vetting the departmental submissions, after the negotiations were done with and the Board itself took a decision, the Cabinet confirmed those decisions and the Department of Agriculture knew how much it had to spend, the de-

partment came back and said that there was a very important project that had come up in the research and development field. It involved setting up an important research laboratory at a key university in the country. They felt it was of such importance and such high priority that they must submit it as an extra immediately. This was discussed with the staff of the Treasury Board in our Program Branch. I am not sure whether this was in Mr. Fry's field.

MR. J. L. FRY, DIRECTOR OF PROGRAM DIVISION RESPONSIBLE FOR ECONOMIC MEASURES AND SCIENTIFIC RESEARCH, TREASURY BOARD: Yes.

Mr. Reisman: It was in that field. Our officers examined this proposal with the Department of Agriculture and were convinced it was indeed a project of very high importance. The question then arose: do we proceed with it or do we not proceed with it in a situation where ceilings were set, so that even before you got under way in the fiscal year you were already beginning to deal with extras, and this in a very tight fiscal year? Some Treasury Board staff including Larry Fry would have discussed this with Mr. Cloutier, who thought it was of sufficient importance to bring it to me. We deliberated over this and took the view that it indeed seemed like a high priority project, but that surely the Department of Agriculture, with a budget of the size it has to spend, should be able to find some leeway in order to proceed with this high priority project. We therefore sat down with the officials and said, "Look here, we think this is a pretty good project. We agree with you that it has a high priority, but would you please select some things in your department that are of low priority that you can do without".

Senator Bourget: The same old story.

Mr. Reisman: They did this. They examined their situation and said, "Well, as far as research and development is concerned, we do not want to make room in that area; everything we are doing there we regard as being pretty close to the bone and we wish to proceed with them. There may be one or two other areas where we can do it." We encouraged them to do so.

The Chairman: I am sure.

Mr. Reisman: They came back as a staff and said, "Yes, we have found one or two places where we may be able to save a few dollars, but not enough to pay for this whole project." We said, "Well, you had better try again." They said, "We have tried. Would you like to make some suggestions." Now this is interesting, because the Treasury Board staff likes to rely on the departments and agencies to take these decisions, or to come up with advice, because they know their departments and they know their programs.

The Chairman: It is a very dangerous proposal to make to you.

Mr. Reisman: They said to us, "Have you any ideas?" We said, "Yes, if you want some ideas we have a few". We put a few propositions to them which they found interesting but suggested they were of very high policy value and very high political importance, and we agreed they were. We suggested they assemble these proposals which would save enough to allow for this major R & D project to go forward and then we would put it to the Board. In the discussions at the staff level we decided this was important enough for the Minister of Agriculture, who is not a member of the Board, himself to appear before the Board. He did, and a good discussion took place. The Board decided that there was indeed a range of non-scientific programs that could be trimmed to make room for this research program, but again because of its high policy content it had to go before the whole Cabinet. That is what happened. It went before the whole Cabinet and on this occasion the Cabinet confirmed the advice of the Treasury Board, so the Department of Agriculture trimmed back those particular projects in order to make room for this R & D project.

Senator Robichaud: I notice you say "on this occasion".

Mr. Reisman: On this occasion.

The Chairman: Which is an exception.

Senator Robichaud: I do not know if this is a fair question, but answer it if you want to; it may have something to do with policy. Is there not a tendency, or has there not been a tendency in recent years, on the part of the Treasury Board, to give more freedom to individual departments? In other words, if a department has a target of, say \$50 million, which it has been allotted and has been told to remain within this target. Is there not a tendency on the part of the Treasury Board to give almost complete freedom to this particular department to select its own programs or give priority to programs which the department itself would chose?

Mr. Reisman: You are quite right. There has been a strong trend in that direction, to delegate a great deal of authority to individual departments within the overall ceilings. That flexibility to departments is particularly paramount when they are preparing their program reviews and when they themselves are putting their expenditure proposals to the board. They have complete freedom at that stage. Once the programs are approved and sent to Parliament as part of the Estimates and then approved by Parliament in the Estimates, there are then some restraints on what they can do.

Within a program there is freedom to move, with the permission of the Treasury Board. As between programs, they can only move with the approval of Parliament. Indeed, such things happen. When we come in with our Supplementary Estimates from time to time you will observe dollar items in the Estimates, which are really designed to move moneys from one program to another, but with the approval of Parliament. So the degree of freedom really turns on what stage of the exercise we are talking about.

I may say too that under this new system of preparing Estimates which has been discussed with the Public Accounts Committee of the House of Commons, and I believe with the Finance Committee of the Senate, whereby there will be fewer programs and more sub-programs and activities within the programs, there should be increasing freedom for departments even after Parliament has passed the Estimates. An idea here is to introduce an element of flexibility so that people do not have to go on spending in a particular direction when the facts and alterations in circumstances suggest that some changes should be made. I do not know if that answers your question, Senator.

Senator Robichaud: Yes, I think it does. You just referred to the new presentation of Estimates, or establishing a new system in the presentation of Estimates. I am wondering if any thought has been given to introducing the system they have in the United States where, for example, on January 1 they publish an analysis of the estimates which will be presented six months later, say in July, and in this presentation there are not only titles and figures as we have in our Estimates, but also a brief outline of, say, the expenditures of the year previous and the expenditure for the coming year. Has any thought been given to introducing such a system?

Mr. Reisman: As I understand it sir, our new form of presenting the Estimates will in fact have a great deal of narrative and descriptive information in it of that kind.

Senator Robichaud: Something like this?

Mr. Reisman: Indeed, perhaps I should tell honourable senators that, in connection with the 1969-70 Estimates, which were tabled two days ago, and which were tabled in the old form with Standard Objects of Expenditure, we will be producing in booklet form for each department a form of the Estimates along the lines of the new system. This will mean that for each department you will indeed have this new program system, whereby you will be able to see both in narrative or descriptive form, and in statistical form, what that department does. It will be in a form that is intelligible. In the past, you knew what a department spent for manpower or pa-

per clips or advertising, but you did not know why they spent that amount, what these particular items meant, or how they related to the purposes for which the department existed. In this new booklet, you will have that information.

Senator Robichaud asked another question, and I do not want to duck it. He asked whether we might turn out that kind of information five or six months in advance. That is a tough question. As it is now, you know that we start on the Estimates a considerable time in advance. We are starting on the Estimates for 1970-71 right now. Indeed, we started in January. The process of moving through the system takes between now and next February, before we are ready to table those Estimates.

In February we will be talking about Estimates which begin in April and run on for twelve months. If we are to be anywhere near on the target, we have got to foreshorten the interval between the work done and the presentation of those Estimates. Otherwise, they would be just a wild guess. We know that the Government has come in for some criticism in the course of the past year because estimates turned out not to be as precise as members of Parliament and Senators would like. The reason is, of course, that the Estimates are exactly what they say they are, they are "estimates", and they deal with a period twelve, fifteen or eighteen months ahead. Circumstances change, things change, emergencies arise. There are programs over which the federal Government has no control, but which are controlled by the provinces, in which the federal Government shares but which are really not under the management of the federal Government. For those reasons, you know there will be some differences between the estimates and the final turnout of expenditure. We hope that the difference will not be very wide. This is a matter we try to keep within reasonable bounds, but it cannot be completely controlled. We think we are pretty close this year. If we tried to present these estimates six months before we do, now, then their precision and accuracy and worth would probably be impaired.

I myself do not know the American system too well but I will undertake to look at it.

Perhaps I could make one other comment. We are working with a pretty spare crew. The Treasury Board staff that deals with estimates, expenditures, program review, is probably not much more than 50 in number. I do not know the precise number that the Americans have, but I imagine you could multiply that by 25 or 30, anyway. They have a big staff. Their staff at the Budget Bureau is hundreds and hundreds of people, and they can afford hundreds of things that we cannot afford.

The Chairman: Our system is different, too.

Mr. Reisman: Our system is different.

Senator Robichaud: In order that members of the committee may have a better idea of what I am talking about, this is a little booklet which is a reprint of pages 123 to 144 from the *Special Analyses, Budget of the United States 1968*. It was published in January 1967, six months in advance of the presentation of their budget. I might put on record a very brief paragraph which gives an outline as to how they present this analysis. It reads:

The continued advancement of science and technology for both national security and domestic progress is an important responsibility of the Federal Government. Federal obligations for research and development are estimated at \$17.3 billion in 1968, as compared with the 1967 estimate of \$17.5 billion. Expenditures are estimated to increase from \$16.5 billion in 1967 to \$17.1 billion in 1968. However, within these relatively level totals, there will be important shifts in the mix of research and development activities conducted by Federal agencies.

So they give a narrative of their budgetary position.

The Chairman: It is a kind of science budget, which apparently it is not desirable to do here?

Mr. Reisman: We are getting right into the heart of it now.

The Chairman: I do not think so, not yet.

Mr. Reisman: You want to withhold that?

The Chairman: I tried yesterday, and I was not successful, to orient the discussion somewhat. Today we should try to ask ourselves the general questions about the overall procedure, and then deal more specifically with science and research—if that procedure is acceptable.

Mr. Reisman: Mr. Chairman, I wonder whether you will allow me a comment on the specific question put by Senator Robichaud with respect to this booklet.

I should say at first, perhaps, that this type of presentation in the United States is presented with their Estimates, and that occurs some six months before the beginning of the fiscal period to which it applies. It is comparable to our tabling of the Estimates early in February which applies to the period beginning on April 1. So we also table in advance.

Senator Robichaud: Three months.

Mr. Reisman: Yes, they are three months ahead. Secondly, we do not at this time prepare this kind of compilation. I should perhaps tell you that, at the

last meeting of the Science Council—of which I am an associate member—a question was put to me in exactly the terms now put by Senator Robichaud. The question was as to whether we would publish such a compilation. My answer at the time—and it is the same answer that I give here—was that within the resources which we have available, the priorities which we have for our work, the personnel we have, we would not at this time choose to do that.

We do intend, as we improve our capabilities, as we computerize our activities over time, to turn out brochures and booklets of an explanatory kind, to help the public, to help Parliament and the ministers, to understand a little more about the whole expenditures pattern. That will be more than is available now through the present publications.

Quite frankly, I myself do not see very much value in the kind of compilation I spoke of before.

I will not tell you why now, because there will be questions put to me, and I will answer very specifically. But what we did say to the Science Council, to the chairman of the Council and his staff, is that the Estimates, in fact, have all the information required to do this kind of work, and that we would render assistance to the Secretariat of the Science Council in making any compilation of data that they feel is useful for their purpose. If the Science Council in its wisdom believes that a compilation of this kind is desirable on a current basis, the data is there, they have the staff, we have offered our help, and they may indeed wish to do it. We think they are proceeding; I believe that contact has already been made between the staff of the Science Council Secretariat and my staff, in order to analyze and obtain data of that kind. Is this right, Mr. Fry?

Mr. Fry: This is true. Last week we were in contact with the Science Council and we have a study group that is getting together, including members of the Science Secretariat. This group is studying this booklet and trying to see how we can be of assistance to the Science Council in providing the information for producing something similar.

The Chairman: Are there any other questions with respect to this chapter on the allocation of resources, describing the general procedure for establishing or determining estimates?

Senator Nichol: I had a question, Mr. Reisman, to which I am sure the answer is clear. In approaching such a problem as research and development there are two ways in which the Government can go at it: either through allocation of funds directly, in which case, for instance, they would appear in your schedule classified by function; or the Government can make a decision that this will be done through tax incentives of some kind, through making such and

such a function of industry tax deductible. Where, then, does that appear? It is a true cost.

Mr. Reisman: Absolutely.

Senator Nichol: This could apply to other things than research and development. It could apply to housing, if, for instance, you decided to apply funds to permit municipalities to accumulate land. Both appear in the field. One appears in the Estimates. Where does the other one appear and how would you analyse those costs?

Mr. Reisman: That is a very vital question. I recall running into this specific problem at the time we converted the program for general incentives to research and development in industry from a tax-type incentive to a direct grants program. You will recall, I think, that in the year 1966 or 1967 that change was made. The new program, referred to as IRDIA, was converted from a tax incentive that had been first introduced in 1960. We were confronted with this very problem of trying to determine what the weight should be of the grant system. We needed data on what was the value of the tax incentive; who was using it; how much value did it have to individual firms? We did an investigation at that time using data from the Dominion Bureau of Statistics and from the taxation division which enabled us to obtain information and data and develop our new program. But you are quite right; there is no place where this happens automatically. The Dominion Bureau of Statistics does certain kinds of research, but to my knowledge they do not publish data on the value of tax incentives. This has to be done almost on an *ad hoc* basis for specific purposes.

The Estimates derive, after all, from a process whereby Parliament has to be presented with a set of expenditure proposals. That is the purpose of Estimates. Its purpose is not for research, but to get authority from Parliament to spend certain funds. The Estimates are not the appropriate place to do it.

On the other hand, you are right, you know; a tax incentive is costly. It is done through another device, but it has the same cost to the economy as would a direct grant. I imagine that, in areas that are, say, in the range of economic policy, it is the kind of research that would be done by the Economic Council on an *ad hoc* basis. If these programs involved tax incentives in the research and development field, I would imagine that the Science Council of Canada in its researches and publications would wish to examine this kind of thing and produce some reports from time to time.

I am sure that if honourable senators were interested in a particular program of this kind, they could request that an investigation or study be made and it would be tabled with this committee.

Senator Bourget: Could you get it through the Department of National Revenue?

Mr. Reisman: It would take a lot of research. If an honourable senator phoned the Department of National Revenue and asked them to please tell him what the total value was of a tax incentive for research and development, he would not get much of an answer. It would take a lot of research to get the answer.

The Chairman: Your former department, the Department of Industry, did quite a lot of work on that, did they not?

Mr. Reisman: Yes. John Orr of that department published a fair amount on that.

Senator Nichol: In terms of this total functional study which begins on page 33, Appendix B, concerning this type of tax incentive, there is no way it can appear in total in terms of these functions.

Mr. Reisman: That is right, sir.

The Chairman: Not only in total, but in part.

I would like to, if at all possible, limit the discussion for the time being to the kind of general procedure needed to determine Estimates, as it is explained in this chapter on the allocation of resources. Then, gradually, we will go to science and research.

Senator Grosart: This automatically takes us into the appendix that Senator Nichol just referred to. For example, I find that for the allocation of federal financial resources the basic principle appears to be, or will be, the division of the functions into six main areas: General Government services; foreign affairs; defence; social measures; education, culture and recreation.

The Chairman: I thought that you would ask a more general question about this chapter before going on to that. I have a vague idea where you are going now, and I would like to try to keep the discussion more general at this stage.

Senator Grosart: I am afraid I am lost, because the chapter you were asking us to discuss, Mr. Chairman, does have to do with the allocation of resources, and this is the whole proposed future plan for the allocation of resources.

The Chairman: Well, go ahead, then.

Senator Grosart: Looking carefully at that chapter, it refers to *expenditure guidelines* and *targets*, and both expressions are italicized. If my question is not in order, Mr. Chairman, please stop me, but what I notice is that recreation, for example, is to be one of

the main considerations in the allocation of resources, whereas science is not.

Mr. Reisman: Excuse me, sir, but perhaps I should correct something very quickly here. This classification is not an instrument in the allocation of resources. It is a system of classifying expenditures in the Estimates in a manner that would make them intelligible to whoever is concerned with the expenditure patter. It is a technique for presenting a picture, making a presentation, putting things into different categories. You are wondering why we put recreation together in one package but do not put research and development into a package.

Senator Grosart: I am going beyond that. I am wondering why you do not put science into a package.

The Chairman: I knew you would raise this point.

Senator Grosart: Let me read this: "The Treasury Board has adopted a functional classification of Government expenditures". If that is not for the purpose of allocation, then it is hard to see what it is for. This will be the guideline for the Treasury Board. Surely this has to be one of the criteria of the allocation of resources . . . "which recognizes that Government activity falls into six main areas or functions . . .". However, I will leave that for the moment.

Mr. Reisman: No, it is an important question, senator, and I should try to clarify it. We explained, I think, in our submission and in the statement made today that we are moving to a system now approved, I believe, by the Public Accounts Committee, whereby the presentation of the Estimates will be by functional programs related to departments and agencies. To take an example . . .

Senator Grosart: What are the Estimates other than the allocation of resources? That is what they are.

Mr. Reisman: I wonder whether I might complete my remarks because it will throw some light on this. Each department and agency will be putting their requests for expenditures under the headings of program activity, and these activities are then divided into sub-programs and specific activities.

Now because a number of departments and agencies may be concerned with the same kind of program, it then becomes desirable, we feel, to take the program activities of a number of departments and agencies and compile them into one, what we call broad functional classification. These as you say are not by departments and agencies—the Estimates proper—will be by departments and agencies but under program headings. Then in addition to that we

will try to pull together under these headings all the activities that fall into a particular program function, and the question is why have we not selected science and research and development as one of the functions, is that your question?

Senator Grosart: That was my question. Actually it was merely a comment, because if I may back it up, I would say when I look at your functional headings I find they are completely inadequate to give any kind of an overall picture by project, or by discipline, of the federal Government expenditure on science. I am aware of your general comment earlier, but on the other hand I am also aware that OECD makes comparisons between countries on the assumption that the total expenditures on R and D, that is to say, science policy, which is the matter before this committee, on the assumption that this has some importance. When the OECD examiners were here they met with this committee and this is the question they kept asking: "What is your total expenditure on R and D? How do you determine the proper channels for science expenditure?" Yet when I look at this document at C39 I find "general research; Social Science Research; Dominion Bureau of Statistics; Economic Council," and then turning over the page I find "Scientific Council (PC); Astronomy and Physics (EMR)"—Energy, Mines and Resources—"Polar Continental Shelf (EMR)". As far as I know those are the total references to science expenditure. Yet we know that many departments are spending money on R and D.

Now my question to you is this, sir: In the allocation of resources, to the extent that the Treasury Board has responsibility and authority, do you think it is essential for the Treasury Board to look at the expenditures by project in various departments? If I may give one illustration, we have had departments before us and we have asked them "When you decide to give grants to ABC universities and for XYZ projects, do you know at that time, when you put this in your estimates, what other departments may be doing in respect to those universities and those projects?" And the answer has always been no.

Now in the allocation of resources, will the Treasury Board in future—I won't worry about the past—but will it in future bring these together in a meaningful way so that if the board were asked: "Would you give us a piece of paper which shows the name of every university getting a grant of public funds, and the projects towards which those funds are channeled—will the Treasury Board be able to produce that tomorrow morning?" If you cannot do that it would seem to mean that you have not had it under consideration.

The Chairman: I knew you would not abide by my suggestion. You are dealing now with science.

Senator Grosart: Yes, because, Mr. Chairman, if I may say so this is a Science Policy Committee and I

am dealing with one aspect of this which is the allocation of resources, and I am dealing with science within the framework of the allocation of resources. I am quite prepared to have you stop me if you feel I am not being guided.

Mr. Reisman: Well, Mr. Chairman, I am in your hands. Would you like me to deal with these comments? There are many, many ways of classifying expenditures, and we have developed a system here which has been discussed with the Public Accounts Committee which in our judgment represents a very considerable improvement over the system that has prevailed up to this date where expenditures have been handled under standard items of expenditure only. What is being suggested here is another form of presenting expenditures.

On this particular question related to science activity, there is room for differences of opinion and differences in judgment as to how one should present this kind of picture, and I should imagine that there are as many views as there are people, and there are as many views as there are interests. What one tries to do is to reconcile all the different points of view and to present them in a manner which seems to make the maximum sense from the point of view of all the needs and all the desires. I myself have a view on this and perhaps you would be interested to hear it. I do not think it makes very much sense to lump together in one figure, except for very limited purposes, say the research done by the Fisheries Research Board on the sex life of the giant clam with the scientific activities of the Department of Industry to promote technological development of the computer industry. I think when you lump those together you do get something. You get a figure. It is an interesting figure for OECD and others who have used the figures for that kind of comparison of total activity of one country in an area with another country. Figures of that kind can be pulled together for specific purposes, the Science Council and the Council on Industry and other departments have lumped them together, and so have we. My own feeling is that that kind of figure has a very limited value. However, if you ask me whether I think it is a desirable way for preparing the Estimates on a standard basis, I must say I do not see much value in it. I do not see how by taking apples and oranges and putting them into one heap you get very meaningful tools of analysis.

It goes back, sir, to my original proposition, which is that science expenditures should really be regarded as a tool, an instrumentality, to achieve certain ends, and can only be understood in any meaningful way in relation to the objectives of the program. That is when they mean something.

Senator Grosart: Does not that apply to every single vote in the Estimates? Is there any vote in the Estimates which is not a means to an end, Mr. Reisman?

Mr. Reisman: I presume all expenditures are important; they are a means to an end. What I am saying is that expenditures on this thing called "Science," to be meaningful, must be looked at in packages. If you want to talk about the Research and Development expenditures to help develop industries, that is a meaningful package of figures, and you can find them in our presentation. If you want to talk about the total expenditures on providing assistance to universities, you can find them under the various program headings. You can find what NRC does; you can find what every other agency and department does; and you can pull them together in a variety of ways to serve different purposes. However, the interesting thing—to me, anyway—is not the thing itself, but the end to which it is directed.

Senator Grosart: We all agree on that.

Mr. Reisman: If you do, I do not think there is much dispute over that.

The Chairman: I think there is some confusion here. You have, in a way, in your system of classification, recognized this, because you have a special item under "Economic Measures", on page C-30, "General Research"; but this classification is far from being all-inclusive.

Mr. Reisman: That is right.

The Chairman: And I think your view would be quite justified, it seems to me, if research programs were intimately integrated or intimately related to the policy responsibilities of an agency or a department. However, because of our federal structure, because of the division of responsibilities in Canada, we have departments or agencies whose main responsibility is to do research. For instance, I see "Forestry" under "Economic Measures," and "Other Primary Industry". Forestry has no policy responsibility whatsoever. I would say that about 98 per cent of their expenditures are devoted to research.

Mr. Reisman: Yes. Perhaps I should explain this, Mr. Chairman. Under this heading of "General Research" we put all those things that cannot be clearly allocated to a departmental program. In any instance where you can attach—

The Chairman: But Forestry is a department of research.

Mr. Reisman: It is a very much mission-oriented department.

The Chairman: Mission-oriented research, but it is research.

Mr. Reisman: It is research directed to the needs and interests of the forestry industry and in the field of forestry. Today they have an Advisory Council drawn from the forestry industry, and they try to gear their research projects to the needs of that industry, and they are very much mission-oriented, but their purpose is not research as such.

The Chairman: That is what they do.

Mr. Reisman: But it is not research as such. It is research and development, to help in developing the forestry industries of this country. The purpose of it is the development of the forestry industries.

Senator Grosart: That is the purpose of all research; there is no research that has not an end in view.

Mr. Reisman: I beg to differ. There is a great deal of research for no other purpose than to advance the frontiers of knowledge. A great deal of research is done in the universities and the NRC which is not oriented to some purpose, what you call "project-oriented," but research for the purpose of advancing knowledge, discipline knowledge, and no other purpose.

Senator Grosart: Let us not quarrel about words.

Mr. Reisman: This is not a matter of words, sir.

Senator Grosart: As far as I am concerned, you say basic research has no purpose other than the advancement of the frontiers of knowledge. That happens, in my view, to be a purpose. But let me illustrate my point...

The Chairman: Not in the sense that he was using the term.

Mr. Reisman: It is not mission-oriented.

Senator Grosart: I was not saying it was. You said that basic research has no purpose except the advancement of the frontiers of knowledge, and I say that in my way of thinking that is a purpose.

To illustrate my point, on page 7 you tell us that total Government expenditures—let me use your exact words:

Federal Government support of all Canadian research and development activity (current and capital expenditures) in universities, in industry and in government facilities increased from \$202 million in 1960-61 to an expected \$520 million during the current fiscal year.

I take it from that that you take the packaging of this rather more seriously than you suggested in your remarks. Moreover, when I look at the table which,

again, is in your brief, which is headed, "Expenditures on Programs and Activities of Departments and Agencies, 1967-68"—that is a year back—"Classified by Functions", and then I add up from pages C-41 and C-42 the total expenditures that you put under the science function. I come up with \$152 million.

I am merely suggesting to you, as an explanation of my line of questioning, that I would like to see those figures reconciled. If you are going to say the Government is spending \$520 million in this field, when you break it down I want to see the \$520 million. That is all I am saying, if you say the breakdown is functioning properly.

The Chairman: Have you looked at the new Belgian Experiment? We had Dr. Spaey before us, and they say they have now introduced in their budget procedure a special science budget, and I understood that there was a kind of Canadian mission which was going to Belgium to study this.

Mr. Reisman: I am not aware of any Canadian mission that has gone to Belgium to study their system. I know Belgium has been experimenting in the direction you indicate, Mr. Chairman. I gather they are having quite a lot of difficulty with it.

The notion of having something called a science budget which embraces in one package all the diverse activities that relate to the use of this particular thing, which is so helpful in so many ways, this has been tried other places as well.

You have had a great deal of evidence on this subject, some of which I have had the pleasure of reading and there is a wide range of opinions as to the utility of that kind of approach.

If you want my own personal view, for whatever it is worth, I will say that I do not believe the Belgians are on the right track. I think they are going to get into a great deal of difficulty with it, and the system will not work. But, this is an opinion. Others have the view that this is a good way of looking at it.

I might, with your permission, sir, just make a further observation on the point made by Senator Grosart. The observation I made about lumping these things together results from the fact that they are, in my judgment, of very little, or limited value. If they are of value to some people in order to compare one period with another, or one country with another, then we put them in for whatever they are worth, but they are of very little worth. They are presented here, and presented with the various reports of the Science Council, as part of the statistics produced. For our purpose, and for the purpose of the Estimates and our system of examining expenditures, we believe that allocating and examining scientific expenditures related to a function is a more useful way of doing it.

If you want these classified in some other way, and make a request of that kind, then we will do our best to meet it, and hope that the information will be of value to you.

Senator Grosart: Mr. Reisman, my function here is to obtain information that we can use in making a report to the Government on what our science policy should be. That is the only end of the questions I am asking. I do not want to pursue this too far, but let me give you another illustration.

First of all, I should like to say that I am not in favour of lumping merely for the sake of lumping. What I am suggesting is that if we do not bring all of these expenditures together under one head then we are unable to examine them project by project. The N.R.C. at the moment, according to the evidence they have given us, has one thousand scientific projects under way. There are probably another one thousand under way in other departments. My view is that unless these are all brought together and then examined project by project we have no way of knowing what overlapping there is in funding, the performance sector, or the project sector. Perhaps I can give you an example from your opening remarks. At page 3 you say:

If we assume that the Cabinet expenditure guidelines place a high priority on programs for industrial expansion . . .

You are using an example here.

Mr. Reisman: Yes.

Senator Grosart:

. . .resources will be allocated to the Department for this purpose. It is then for the Department itself to determine the mix of instruments to achieve its goals.

Personally, I do not agree that that is a valid way of going about it, because you give a further example, and say:

These will include financial assistance, commercial policy, export assistance and also a substantial component of aid to industry to help it develop its scientific and technological capability.

So, you are in this area.

Mr. Reisman: Yes, sir.

Senator Grosart:

I can cite similar examples for other departments and agencies which carry on extensive projects in the field of science and technology in order to further their program objectives.

And then you cite Atomic Energy of Canada Limited, the Department of Fisheries and Forestry, the Department of Energy, Mines and Resources, the Department of National Health and Welfare, the Defence Research Board, the National Research Council, and the new Department of Communications, all of which are to decide their own mix. Yet, interestingly enough, every one of these departments has at the moment some kind of research going on in water pollution, or is taking some responsibility for it, although I grant you that the overall responsibility has been given to the Department of Energy, Mines and Resources.

What I am suggesting to you is that the meaningful kind of informational analysis of the Estimates, or the allocation of spending, would be one that would tell us what is being spent on water pollution research development by these agencies. It is the lack of this information in any attempt to formulate science policy that concerns me.

Mr. Reisman: If I understand your comment correctly, sir, I think we are getting awfully close to one another in our thinking, because here what you want is not something on science policy generally, but scientific expenditures in relation to water pollution.

Senator Grosart: Yes.

Mr. Reisman: Water pollution is a program, and a variety of things are done in connection with water pollution, of which scientific activity is a very important component. There, indeed, would be a coherent collection of data or evidence in relation to a program or in relation to a sub-program.

Senator Grosart: Are we going to have it, do you think, in your new program in the Treasury Board? Do you think you are going to be able to go this far and separate water pollution, air pollution, and . . .

Mr. Reisman: I think that really it is a question of how refined the data will be. I think from our new presentation you will be able to get a good deal of information of exactly the kind you are seeking. The question is whether it will be sufficiently refined for your purpose? We do not in these Estimates go down to the scientist's bench, or his lab, and specify in the Estimates every single project, and every single undertaking, that he can engage in that has a scientific content. I think if we tried to do that we would wind up with a book of estimates that would be a good deal thicker than an inch and a half or two inches.

But, I will say this, sir, that within the Government apparatus there is an inter-departmental committee with respect to pollution. The purpose of that inter-departmental committee is to deal with exactly the kind of problem you point to. There are quite a few

agencies that are engaged in work relative to pollution, and it is essential that they do not overlap or duplicate, or that they do not misuse resources. Indeed, I believe it was a Treasury Board proposal that led to the creation of that interdepartmental committee. The central responsibility in respect of pollution was placed with the Department of Energy, Mines and Resources, but there are other departments, such as National Health and Welfare, Forestry, Fisheries, and Northern Affairs, all of which have programs in this field. We try, through the interdepartmental machinery, to co-ordinate all of the scientific activity and other activity related to pollution.

Let me give you an example. Not very long ago one department of Government proposed that it wished to elaborate its activities with respect to air pollution. The question arose as to whether that was the right agency to do it, or whether, in fact, it might be done even now by another agency. When this proposal was submitted to the Cabinet, and the Privy Council office, when they examined that proposal, they put a question to the submitting department: Did you, in fact, have this project examined by the interdepartmental committee? The answer was: No. The Privy Council office in this case put it back to that committee, and that committee examined it to see if, in fact, the work was not being done by someone else, or could not better be done by someone else, and certain decisions were taken in relation to it.

Your question is: How can members of Parliament, and how can senators, have that kind of data before them?

Senator Grosart: Let me go beyond that. We are dealing with allocation of resources. My question is: How can the Committee of the Cabinet on Science Policy make its decisions if it does not know immediately, when this book is before it, how much is being spent in a specific area? Suppose somebody asks: How much are we spending in total on water pollution?—and that, surely, is a question that a member of the science committee of the cabinet, if it ever meets, would ask. I will not ask you how often it does meet, but if it met and somebody asked that question, would he not be entitled to an answer, and would he not be entitled to an answer to a similar question in respect of air pollution, or fallout?

Mr. Reisman: There is no question whatever, senator, that if questions like that are put they can be answered. Let us assume that the Privy Council committee on Scientific and Industrial Development schedules a meeting to deal with the subject of water and air pollution.

The appropriate procedures relative to a meeting of this kind would be for the secretariat that serves that committee—and as I understand it the secretariat serving that committee would be drawn from the Privy

Council Office, and would be personnel from the Science Secretariat—would be preparing material, papers and documents, to present to that committee in order that the committee of ministers in examining that item on the agenda would be as well informed as they could be in dealing with the matters before them. There is enough data available within the stream of government data to be able to answer this question.

But, you know, there is an infinite number of questions that can be put, and some of them, because they are put often on a regular basis and should be known, are printed and presented annually, either through the Estimates, or through DBS, or the reports of the Science Council, or in other ways. Those questions are quite specific to the purpose in hand, and between the Science Secretariat, the people on the Treasury Board, other officers and other agencies, a lot of answers can be obtained to a lot of questions very quickly. To meet the specific needs of the ministers, to try to anticipate all the questions and put them on a regular basis, is really quite a massive type of operation.

Senator Grosart: I agree.

Senator Cameron: I think we all have a lot of sympathy for the position in which Mr. Reisman finds himself in this very difficult job, but at the beginning he stated that the Treasury Board does not lump all research and development into one package. This relates to what Senator Grosart has been saying. Instead they recognize that each department must do some work on its own. We accept this. However, we have been sitting in this committee now for some months, and I think I am not alone in having the impression that this approach has resulted in a feeling that in government programs there is a duplication of effort, there is a lack of co-ordination and there is general confusion as to the achievement of goals.

I am wondering about the approach you have suggested. I can understand your point of view, that there is not too great a value in lumping all the carrots, potatoes and sausages and so on together. However each department is going off on its own, and I am sure I speak for a lot of members of this committee when I say that the impression we are getting is that there is duplication of effort and lack of co-ordination. It is our job to see if we can come up with some reasonable answers to it.

The Chairman: Or perhaps some balance between different research sectors. However, it is very difficult in certain fields. For instance, we do not even know what the federal Government is spending on research in the field of the social sciences. Do you know? Do you have a figure?

Mr. Reisman: A single figure?

The Chairman: Yes.

Mr. Reisman: That too, you know, is quite a lump.

The Chairman: It is a lump, but you have a lot of lumps there in your classification.

Mr. Reisman: You do have a lot of lumps. I think that part of the difficulty arises from the concept of national science policy and policy with respect to science activity in particular areas. For example, there is a national policy with respect to nuclear energy and nuclear science. There is a policy and there are two organizations: there is AECL and the Energy Control Board. The Energy Control Board is basically a regulatory agency, but at the time it was set up it was also given a function in respect of the allocation of moneys to promote research in the universities and other institutions.

The Chairman: Pure physics.

Mr. Reisman: In pure physics. Well, it is really nuclear physics. Let me make this point and then I will go back to the social sciences. The national science policy really comprises a series of policies with respect to sectors. There is a policy in respect to pollution, a policy in respect to nuclear energy, a policy in respect to fisheries, a policy in respect to industrial research and development, divided into two, civilian and military, defence. You also talk about a national science policy in the sense of comprising all those features. Together they make up a national science policy.

The Chairman: But at the end we get a policy by accident.

Mr. Reisman: I think that is true, sir.

Senator Grosart: There is the most general agreement that the result of our science policy, such as it has been in the past, has resulted in a very serious and costly imbalance between the funding of R & D between government in-house, universities and industry. Everybody who comes before us claims "We are changing this". They are giving us evidence of how they are switching funds from one to the other. This imbalance has developed, and if it is as serious an imbalance in science policy as we are told it is, surely the whole process of decision-making has caused this. All we are asking here is: can we get a better policy in the future so that this kind of serious imbalance, which makes us as a nation subject to serious criticism, can be avoided? Is there some way we can avoid this in the future? Is it not absolutely necessary to lump together for the purposes of comparative analysis the total public funding of R & D in industry, in in-house, in universities? It seems to me from the evidence we have had that the lumping together of these things in these categories is absolutely necessary. The fact is that you have lumped

them together in three parts. You *have* lumped them together in whole.

Mr. Reisman: With regard to the observation that there are changes being introduced into the mechanisms for decision-making, there is no question about that whatever. We are constantly improving in many, many areas.

The recent creation of a Science Council of Canada, the introduction of a Science Secretariat, the examinations that are taking place in respect of the mechanisms for decision-taking, not only in this area but in many fields, are undergoing changes in refinement and improvement on a steady basis. Circumstances change, needs change. I do not want to be in the position of trying to defend everything that was ever done in this area or in any other area; there is always room for improvement. What I see in the process now is a very considerable improvement taking place, both in terms of mechanisms and in methods for the whole process of resource allocation—which is, after all, the heart of what government is about. In fact, I think one can honestly say that the most essential mechanism in respect of the allocation of public resources is government. I mean, that is why government was invented.

Senator Grosart: Also to get the resources.

Mr. Reisman: To get them and allocate them, and they are improving their techniques progressively in the whole system we have talked about here. Really sometimes it frightens me when I recall that four, five and six years ago each department and each agency in government, when putting forward its proposals for expenditures, did so under categories which had no relationship at all to the end objective of the existence of that department. They said, "Give us so much for travel, so much for people, so much for stationery, so much for advertising" and for God knows what. This was the system and the only system. It was a control system in terms of total moneys and nothing else. This apparently has been the system, not only in Canada but all over the world, since time immemorial. It is only recently we have been beginning to ask ourselves whether we cannot do better than that, cannot we look at why we are making these expenditures and whether we have examined the alternative ways of doing it and whether there is duplication between that fellow and that fellow—and we are moving in that direction. If you are asking, Senator Grosart, for perfection overnight, or whether we will ever develop a perfect system to prevent overlapping and avoid imbalances of the kind you are referring to, I would say we are going to get along better than we are now but I do not think we will ever be perfect.

Senator Grosart: Mr. Chairman, I would not want to be misrepresented in what I have said, because I

have not suggested that the mechanism should be or will be perfect. I might say in that regard that when I read the new systems that are coming along, if they work as well in practice as they do on paper, I would not be asking any of these questions.

Senator Cameron: Mr. Chairman, we have a tough job to do—and so have you—we are going to be wasting a lot of our time in committee, unless we can get some better answers than we are getting, as to the total inventory of money being spent on research in Canada, what it adds up to in total, and how it is broken down. It seems to me it is not too difficult to prepare a chart, which would be really an inventory of Canadian research in process and projection, and that this chart could be broken down into the different divisions. There might be 100 divisions and we would know what is going on and how much each one costs. We are not getting that kind of information and I think that before this committee can do its job effectively, we have got to have that information.

A little earlier, you said that the Treasury Board is not a policy making body, and I think that, theoretically, that is true; but I also think that you must recognize that, through the exercise of its veto power, the Treasury Board is a policy making body. For example, take the ING project. Here is a project recommended by the National Science Secretariat and recommended by the Research Council. Who turns it down? The Treasury Board.

Mr. Reisman: That is not right, sir. That is quite incorrect.

The Chairman: Yes.

Mr. Reisman: Perhaps I could speak to that, if you would put a question and I can answer it.

Senator Leonard: Could you have turned it down?

Mr. Reisman: The Treasury Board itself? Very unlikely. It is very unlikely, but I will speak to that point.

Senator Cameron: But this is the answer we get.

The Chairman: There is always the power of appeal from a decision of the Treasury Board to the cabinet.

Senator Leonard: That is right.

Senator Cameron: The effect is the same. We ask this question. Who turned it down? The Treasury Board. This answer may inaccurate, but it is on the record.

Mr. Reisman: The record should be corrected, sir.

Senator Cameron: I know there is an appeal to the cabinet on a decision of this kind but where that is done, in effect you are exercising a policy role and I think we must recognize that, because this has very far-reaching implications. This is not a criticism of you, but it is a result.

Mr. Reisman: Would you want an observation about ING, sir?

The Chairman: I think it is implied in the question.

Mr. Reisman: I will be very happy to talk about it for a few moments. The ING project, as senators know, was initiated by AECL.

Senator Leonard: That is right.

Mr. Reisman: They engage in a wide range of research and development activities related to the peaceful use of nuclear energy and they have some very very high-grade scientists, perhaps among the best in the world. They have engaged in programs and activities which I suppose, if one summed them up over the period of their existence, by now exceed half a million dollars. I am quoting that figure out of the air, but it is certainly a very very large figure indeed, and I think they have large on-going programs from year to year.

This year, in the submission from that agency, they had all the things that they wanted to do, for which they wanted money, similarly for all the other departments and agencies. I mentioned earlier that, when you took together all the requests made by all the departments and agencies, we were something like a billion dollars or better over what the Government said they had available for that year. In the course of our examination of all the departments and agencies, when we came to AECL, we told them that our interpretation of the guidelines laid down by the cabinet meant that this, this and this fitted, this and this did not seem to us to fit.

We had discussions with that agency. Some of their projects were very high on their list and some of them were low on their list. They told us that they very much wanted to go ahead with the intense neutron generator but that they regarded it as low man on their totem pole, that there was not any other activity that they engaged in over which ING would take precedence, and they very much wanted to proceed with ING, but they would need additional resources over and above those that fitted the guidelines.

In the case of ING, you had a major scientific project. In fact, probably much more major than the indications that have been given thus far.

If my memory is correct, it is a project which, in terms of capital outlay, is suggested would cost about

\$125 million and then cost something between \$20 and \$25 million a year to operate, in perpetuity.

Perhaps I might say that, in the information that I myself have had access to over the years, both in the Department of Industry and now in the Treasury Board, it seemed as if the figure of \$125 million, while perhaps the best figure that could be made available at that time, could easily have reached figures three and four and five times that figure.

Renowned scientists in the United States in the nuclear field, with whom I had discussions on this subject two and three years ago, told me that in projects of that magnitude, and around which there was that much uncertainty, both of a technical and of a scientific and an industrial character, that any figure one used in terms of its cost was a cockshy and nothing more and that the figures could much more easily run up to much larger figures.

In circumstances where you had a report from the Science Council, where that report itself was based on many reports from departments and agencies and universities and institutions, not all of which led in one direction, I might say, and where there was a commitment, a decision of Government, to proceed with further exploration and to spend further sums, with a view to determining both the technical feasibility and other unknown elements about it, the Treasury Board staff took the view that this was far too important a matter to be decided at the official level between the Treasury Board staff and the AECL.

Therefore, what they did, in the first instance, was to put it to the Treasury Board proper. They said to the Treasury Board: "Now, look, here is the situation about ING, here is what we know and here is what we don't know; here is what the Science Council said; here is what the Department of Industry said, and here is what the Science Secretariat said." We laid it out for them and we said that if they were determined to keep those budgets within those limits, ING would have to go. We gave them our advice and they had a good discussion on this subject. They took the view that there were indeed some very large questions still to be answered about that project, in terms of total science in Canada.

It was one of those large projects that require that kind of attention. They said, "Well, we had better go a step further. We think this is the right answer, but this is so important that we had better take this up to the Planning and Priorities Committee of the Cabinet over which the Prime Minister presides and from there to the Cabinet." There were very full discussions about this, and in the end the Government as a government decided not to proceed with that project at this time.

Now, any decision is subject to all kinds of views. There are many people who think that that was not a wise decision; there are many other people who

think it was a very wise decision. It is in the realm of politics. It is in the realm of views, and, no doubt, there will be differences of opinion about it, but the decision was taken at the very highest level and I think I can fairly say that any project of real significance certainly goes to Ministers and often goes beyond the group of Ministers on Treasury Board up to the very highest level.

And that is the history of it so far as I know. I have discussed this matter with Lorne Gray of AECL on a number of occasions and he has told me in no uncertain terms that from his point of view, from the point of view of his staff and from the point of view of the board of directors of that organisation, ING has the lowest priority on their scale of priorities. They would like to do it, but there is not anything else that they would wish to put aside in order to do it.

Now, I want to go one step further here, just as an indication of how these things work. Following the approval of the AECL budget for the fiscal year 1969-70, some important new developments occurred which impressed themselves on the AECL management as requiring a new decision. They felt that the development of nuclear energy plants in this country, and in terms of world marketing, was such that somebody in Canada should, and, if no one would do it privately, AECL should, proceed with construction of a heavy water plant based on the Douglas Point Operation, where certain economies could be achieved by virtue of their on-going operation. They discussed this with the Treasury Board staff and they discussed it with the Ministry of finance staff, and they indicated that this was in their judgment one of the most urgent projects in—call it the scientific field. It is really in industry, very closely related to high technology.

On the staff side we encouraged AECL to put their proposal forward, but again because of its magnitude and because it occurred after budgets had been set, their proposal was taken to one of the Cabinet committees. It did not go to the Treasury Board at all. It was of sufficient importance to go directly to one of the Cabinet committees. I cannot recall which committee it went to. I think it went to the Planning and Priorities Committee.

Senator Grosart: It probably did not go to the Science Committee.

Mr. Reisman: Now that you make that remark, I believe in the first instance that it went to the Cabinet Committee on Economic Policy and Programs, being a project for an industrial plant.

The committee examined this and decided in the circumstances of the day, given the financial restraints, that no additional funds could be made available this fiscal year, but that, if room could be

found within a budget, they would be prepared to have another look at it.

AECL went back and examined their affairs and decided that there were other things that were not of as high priority as that project, and they came back to the Cabinet with a proposal which at least for the coming fiscal year would provide the necessary resources to launch their program. It was examined again in great detail and a great deal of evidence was submitted and it went through on that basis.

I am getting awfully close to our intimate decisions within Government, and, indeed, I may have overreached myself a little bit. However, you see there is machinery. There are no arbitrary decisions on big matters of this kind. They do go through the process and in the end have to be settled through the political process. I do not see any other way, really, of doing it.

Senator Cameron: Mr. Chairman, we are indebted to Mr. Reisman for his very frank answer, because, if you will read the record, you will see that your statement and the information we have been given do not quite coincide as to where the responsibility arises. However, I only raise this because this is the crux of the sort of thing this committee is set up to do. We have to try to find how to evolve science policy for Canada and how it can be implemented. I think we have some ideas as to where the weak point is. I am not going to get into a discussion of that now, but this is a good illustration of the dangers and risks to be taken in formulating a high-level policy with a long-range productivity such as the ING project. And I am thinking of something which we are going to have to face very soon in another field, the social sciences.

Again, one thing that stands out like a sore thumb is the almost complete neglect of this huge dynamic area today. We know there is an explosion of unrest in the universities, and it is not something that is going to be pushed aside, because it is not just affecting the universities. It is going to affect fundamentally the whole life and times of this country, and I am hoping that we do not find ourselves in a similar position, where, rightly or wrongly, we fail to see the importance to the country of a particular long-range project which may be raised. This was one decision that was made, as you say, at the highest Cabinet levels. All right. Did they have the time to

analyse all of the implications of what might happen 15 years from now as a result of this decision? However, in this other field where we are practically doing nothing, we may come up with something similar and it underlines the importance of this committee being able to get every bit of evidence that it can get as to the costs, the long-range implications and who is to take the final responsibility.

Senator Grosart: Hear, hear.

Senator Cameron: Again I am grateful to you, Mr. Reisman, for the answer you have given us; we have every sympathy for your position.

Mr. Reisman: From my reading of the evidence, sir, you are getting an awful lot of very valuable material from many, many people.

Senator Cameron: Yes, we are.

Mr. Reisman: If there are specific pieces of information that you want that we can pull together, we will be glad to do that. The science Council, as we indicated a little earlier, do see value in making a number of compilations that are peculiar to their needs that we do not require for Estimates purposes. We are going to be helping them in putting it together. The Science Council, after all, now have a staff of their own, and they will probably tell you that when they went to the Treasury Board we pared their staff down a little. We did. Not everybody gets everything he wants. In fact, nobody gets everything he wants. But the Science Council have a good staff of a significant size and they will be producing material of a kind that will be supplementing in a very considerable way material that has been lacking in this country in this area. I tell you that by way of information.

You have touched on a number of important points with respect to organization and mechanism, for taking decisions affecting research and development and science. We have not gone very deeply into them yet, Mr. Chairman. I think you will want to, but I am in your hands on that.

The Chairman: I have a long list of questions here that I intend to raise at some stage. In the meantime, perhaps we should adjourn now and I thank you provisionally.

The committee adjourned.

APPENDIX 27



CANADA

BRIEF
TO THE
SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE
SENATE OF CANADA

Submitted by:

The Secretary of the Treasury Board

January 1969



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INTRODUCTION

This Brief is submitted to the Senate's Special Committee on Science Policy in response to its request for submissions from the Federal Government. Since the Treasury Board is not an operating department or agency expending funds on the performance or support of its own scientific activities, the Treasury Board Secretariat has addressed itself only to those questions in the Committee's "Guide for Submission of Briefs" which it has considered relevant to Treasury Board responsibilities. *

THE TREASURY BOARD AND ITS FUNCTIONS

1. Order in Council No. 3 of July 2, 1867, established the Treasury Board as a Committee of the Privy Council and its status is confirmed in the provisions of the Financial Administration Act, including the most recent amendments of the Act in 1967. In practice, the Treasury Board operates as a Committee responsive to the direction of the Cabinet. The Board is composed of the President, the Minister of Finance, and four other Ministers or their alternates, and has a supporting Secretariat headed by the Secretary and three Assistant Secretaries.
2. The Board meets weekly, or more often when necessary, to decide upon or recommend to the Government courses of action regarding administrative and financial issues arising from the operation of Government. The decisions and recommendations of the Board are tempered by two overriding general considerations: first, the decisions or recommendations must be consistent with the broad policies and priorities of the Government and, second, they must be practicable of being carried out within the resources and powers of the Government.
3. Within the powers conferred upon it by the Financial Administration Act, the Treasury Board may act for the Privy Council on all matters relating to general administrative policy in the Public Service, organization of the Public Service, determination and control of establishments, personnel management, financial management, the review of expenditure plans and programs, and the determination of program priorities. The role of the Board in the executive structure of government is similar to that of a general manager with responsibility for the overall control and coordination of the administration and expenditures of government. A more detailed description of the responsibilities and powers of the Board is contained in the extract of the relevant sections of the Financial Administration Act attached as Appendix "A".
4. While the Treasury Board occupies a central role in the management of the financial, personnel, and general administrative affairs of government, the ultimate authority resides with the Cabinet under Section 5, Subsection 4 of the Financial Administration Act, which states:

"The Treasury Board in the exercise of its powers under this or any other statute is subject to any direction given to it by the Governor in Council, and the Governor in Council may by order amend or revoke any action of the Board."
5. In practical terms, the Board is engaged in the supervision of the execution of the policies of the government, not the formulation of the policies in other than the management function. Unquestionably the Board's surveillance of the operations of the Public Service in total and the nature of the information flowing to it in the normal course of business lend weight to its advice on broad policy matters. However, it would be mistaken to believe that the Board's influence in policy formulation generally, albeit important, goes beyond its role as one source of advice among many.

THE ORGANIZATION OF THE TREASURY BOARD AND ITS RELATIONSHIP TO OTHER GOVERNMENT BODIES

1. As a Committee of the Privy Council, the Treasury Board is an arm of the central executive of government. The unique nature of its responsibilities and powers requires continuous and direct access to other arms of the executive and to all the departments and agencies of government. The formal organization charts indicating the Board's position in the executive, and the internal organization of the Treasury Board Secretariat, are attached as Appendix "B". The charts do not, however, convey the immediacy of the Board's communication with other elements of the executive such as the Privy Council Office, the Department of Finance, the Public Service Commission, and with departments generally. Continuous formal and informal consultation at Ministerial and staff level on policy and administrative matters is a fundamental feature of the Board's operations.
2. The time and attention of the Ministers of the Board can only be given to those matters having substantive administrative, financial, or policy implications. It is the function of the Board's Secretariat to provide for the efficient administration of the Board's business within the framework of the general policies, regulations, and procedures approved by the Board. Matters falling within this administrative framework, or which are capable of being brought within it by staff negotiations, can be dealt with by the Board as routine. Less routine matters, which in the judgment of the Secretariat pose issues of policy, precedent, legality, major financial commitment, or other cause for reservation, are placed before the Board with the recommendations of the Secretariat for full consideration and decision. In broad terms the Treasury Board staff is responsible for surveillance, investigation, coordination, negotiation, and advice in regard to the matters within the Board's jurisdiction, but the power of decision remains unequivocally with the Ministers.
3. The Treasury Board Secretariat is organized in three functional branches, and shares the service of a fourth administrative branch with the Department of Finance. The three functional branches, each under the direction of an Assistant Secretary, are:
 - (a) *Personnel Policy Branch* — Responsible for the development and administration in co-operation with departments of all aspects of personnel policy in the Public Service. The maintenance and improvement of the quality and the productivity of the Public Service through the effective management of human resources is the primary objective of the Branch. Staff relations, including collective bargaining and the resolution of grievances, compensation and conditions of employment, classification of personnel and general matters concerning the supply, training and advancement of personnel are all within the responsibilities of the Branch.
 - (b) *Management Improvement Branch* — Responsible for the development and initiation of sound managerial methods, the promotion of efficiency in government operations and the surveillance of management practices in the Public Service.
 - (c) *Program Branch* — Responsible for the continuing examination and appraisal of departmental and agency programs and expenditure proposals as to purpose, scope, scale, merit, cost, timing and effect in relation to the policies and priorities established by the government. The Program Branch carries out the annual review of departmental 5-year plans and prepares the Estimates for presentation to Parliament, with the assistance of the other branches where necessary.

4. The focal point of the Board's administrative connection with the departments and agencies of government on matters of program content and expenditure is the Program Branch. For the purposes of this Brief it will be useful to describe the structure of this Branch in more detail because of its primary role in the review and appraisal of departmental expenditure programs and the allocation of resources by the Board. The organization of the Branch reflects the main functional groupings of government programs, with the programs included in each group having some commonality or inter-relationship of objectives. The five functionally oriented divisions are:

- (a) Program Division I – General Government Services
- (b) Program Division II – Defence Services
- (c) Program Division III – Economic Measures and Scientific Research
- (d) Program Division IV – Social Measures and Cultural Services
- (e) Program Division V – Transportation, Works, and Telecommunications

5. In addition to the five divisions noted, the Program Branch includes two divisions having specialized responsibilities:

- (a) Estimates and Supply Procedures Division – Responsible for the consolidation and production of the Estimates, and coordination of presentation of the Estimates and appropriation (supply) matters and bills to the Board.
- (b) Planning and Analysis Division – Responsible for the development and institution of planning and analytical procedures, and the analysis of the total expenditure.

6. Program Divisions I to V are responsible for the review and appraisal of the plans and operations of departments and agencies falling within the broad functional area assigned to each, as indicated on the lower part of Chart 2 of Appendix "B", Part 2, under the heading "Divisional Responsibility for Departments and Agencies". This organizational arrangement facilitates the coordinated examination and assessment of related expenditure programs in the light of the government's broad policy objectives and priorities. It will be noted that the majority of the departments having specialized scientific or technical elements are grouped in Division III with others whose missions are primarily economic in character. Exceptions are the Defence Research Board in Division II, and certain others associated with transport and communications in Division V. Social sciences are largely included in Division IV with social services and cultural affairs.

7. The Secretariat of the Treasury Board currently employs approximately 220 officers and a supporting administrative and clerical staff of 160. Of the 220 officers, 140 are involved in the more detailed regulatory functions associated with the Personnel Policy Branch, with 55 in the Program Branch, and 25 in the Management Improvement Branch. The amount included in the 1968-69 Estimates for total administrative costs of the Board is \$5.1 million.

8. Because of the wide variety and complex nature of the problems inherent in the Board's supervisory role, the staff of the Board is largely composed of officers with previous experience in the intermediate to senior levels of management in the Public Service, and in many instances the private sector as well. Although the staff includes officers of widely diverse background, the officers of the Program Branch who deal with departmental expenditure programs are not selected on the basis of expert knowledge in particular program areas, but rather on the basis of administrative and executive training and experience and their general ability and judgment. Where an issue under examination demands highly specialized knowledge, advice is obtained from qualified Public Service or independent sources.

THE ALLOCATION OF RESOURCES – PROCEDURE

1. In outlining the functions and organization of the Treasury Board emphasis has been directed toward its role in the allocation of resources. Although it will be apparent that resource allocation is only one facet of the Board's activities, it is the one that most affects the question in setting priorities among competing demands for federal financial support, be it in the field of science and technology or any other area of federal expenditure. It is, therefore, appropriate that we examine the procedure through which decisions concerning resource allocation are made for all types of federal expenditure.
2. The starting point for each department and agency whose funds come from Parliamentary appropriations, in whole or in part, is the annual preparation of five-year forecasts of their respective year-by-year plans, including the financial and personnel resources required to carry out those plans. This procedure, which was launched about two years ago, is known as the Program Forecast Submission and is made in the spring of the year. In preparing the Program Forecast, departments are faced with making choices between many desirable projects, some of which may be in the field of science and technology. All proposed programs or activities within a department, whether scientific or otherwise, compete for the resources available. It goes without saying that the selection process on the basis of costs and expected results is a most difficult exercise.
3. To assist in the making of choices, the Treasury Board seeks direction from the Cabinet in the form of *expenditure guidelines* and these are made known to departments and agencies to guide them in preparing their Program Forecast Submission. While these guidelines are, by their nature, quite general, they are the product of detailed consideration by Ministers in the light of the best economic and financial analysis and other information which can be provided. Forecasts of revenues, the state of the economy, the condition of the financial market and other relevant factors provide the basis for the formulation of expenditure guidelines for the ensuing fiscal year. Technical and expert staff support which may be required by Ministers in drawing up the guidelines is provided by the Department of Finance, the Treasury Board Secretariat and the Privy Council Office, each in their respective fields.
4. While each department attempts to the best of its ability to reflect the Cabinet expenditure guidelines in its own programs as presented in the Program Forecast Submission, it is inevitable that a national overview has to be made of the total package of Program Forecast Submissions if only because we are always in the position of having more claims on resources than there are resources available to sustain them. Accordingly, the Treasury Board Secretariat examines the total group of Program Forecast Submissions against the same set of Cabinet guidelines and the total amount of resources available for the coming year. This examination yields, after detailed discussion and negotiation with the departments of the goals and objectives of their proposed programs, a set of departmental expenditure and manpower *targets* for consideration by the Ministers of the Board and subsequently by Cabinet.
5. Departments thereby receive approval in principle of their plans for the ensuing year so that they can proceed with more precise Budget estimating and planning, in the knowl-

edge that, barring unforeseen developments, their Estimates will probably be favourably received so long as they do not exceed the targets.

6. The product of this detailed planning is the Main Estimate submission to Treasury Board by each department setting forth the detailed expenditure on which, in the form of the "Blue Book", they propose to seek Parliamentary approval.

THE PLANNING, PROGRAMMING AND BUDGETING SYSTEM

1. The Treasury Board is critically aware of the difficulties involved in decision-making involving choices between competing programs at the national level. Despite the close cooperation with departments at all stages in the preparation of the Estimates, differences of opinion inevitably arise. This is not surprising when one considers the diversity and the magnitude of government operations.

2. In order to facilitate this decision-making process, the Treasury Board has initiated a recently developed system known as the Planning, Programming and Budgeting System (PPBS). In fact, the 5-year Program Forecast of departmental activity mentioned in the previous section of this Brief represents an initial step in the PPBS process. A Treasury Board document on the PPB System, which has been circulated to all departments and agencies, is attached as Appendix "C". To facilitate the introduction of PPBS into government operations, a one-week study course highlighting its key features was recently inaugurated for senior government officials. When the weekly courses have been completed about 400 senior officials will have a working knowledge of PPBS and will be able to oversee its introduction at departmental and agency levels.

3. A central feature of PPBS is the importance it attaches to objectives and results — that is, to the output of a system. The entire approach is geared to a closer examination of goals and objectives and of alternative means of attaining them. The purpose of the system is to assist management in the whole process of decision-making. One should, of course, not claim too much for PPBS, or pretend that it will, by itself, produce an infallible priority rating system or that it can ever supplant judgment. We believe, however, that it can be a valuable management tool and we intend that it be used in that spirit.

4. A further step in the introduction of PPBS has been taken in requesting departments to submit their 1969-70 Estimates in a new form. This new form will consist of a clear definition of the departmental objectives and a description of the programs being undertaken by the department to achieve these objectives. In this way it will be possible at a glance to identify the complete cost of any single departmental program. Ultimately, we hope that we will also be able to evaluate the effectiveness of each program. Unnecessary and irrelevant detail that appear in the existing form of the Estimates will, therefore, be eliminated. For the sake of continuity, however, the 1969-70 Estimates will be presented in the new form as well as in the traditional form. Commencing 1970-71, it is intended that Estimates appear in the new form only.

FEDERAL SUPPORT OF CANADIAN SCIENCE AND TECHNOLOGY

1. In the review and analysis by the Treasury Board of proposals having scientific and technological content, an assumption is made that science and technology are important to productivity and economic growth, and in the solution of social problems. In the words of the Honourable C.M. Drury, speaking to the 1968 Tripartite Chemical Engineering Conference on September 23, 1968:

"....There is a growing awareness in Canada of the importance of science and technology to our economic and social progress and a corresponding concern with the establishment of a national science policy and planning for its effective implementation."

2. While no one has yet succeeded in formulating a general theory relating investment in science to economic progress — a theory which might rationalize or compel the allocation of some optimal percentage of the GNP to science and technology — the empirical evidence suggests a cause and effect relationship. An awareness of this apparent relationship has influenced the decisions of the government affecting science.

3. Federal Government support of all Canadian research and development activity (current and capital expenditures) in universities, in industry and in government facilities increased from \$202 million in 1960-61 to an expected \$520 million during the current fiscal year. Characteristic of this period was a gradual increase in federal support of industrial R&D (from 9% of total federal R&D spending in 1960-61 to a current estimate of 17%) and of university R&D (from 6% in 1960-61 to a current 18%). On the other hand support of government intramural R&D has fallen from 84% of total federal R&D spending in 1960-61 to a current estimate of 62%. (See Table I of the attached Appendix "D".)

4. The impact of this gradual but decisive shift in emphasis, during the past eight or nine years, of federal R&D support from its own facilities to industry and universities is very evident in Canada's Gross National Expenditures for R&D (GERD). The percentage of GERD accounted for by federal government in-house R&D activity has fallen from 53% in 1960-61 to a more current figure of 33%. In contrast industrial R&D has risen from 29% in 1960-61 to a current average of 41% and university R&D from 15% in 1961-62 to 26%. (See Table II of Appendix "D".)

5. These statistics demonstrate that the federal government has been playing a significant role in the financial support of Canadian R&D activity. While its share of GERD is less today than it was in 1960-61 the federal government still funds about 50% of the national R&D effort: (See Table III of Appendix "D".)

THE EFFECTS OF TECHNOLOGICAL CHANGE ON TREASURY BOARD OPERATIONS

1. The most pronounced effect of scientific advance and technological change on the tasks performed by the Board is in the increasing cost, range and complexity of the matters it must consider and decide upon. The ubiquity of science in Government and society has enormously multiplied the alternatives for action, and in ways that are difficult for the layman to comprehend. This circumstance reinforces the need for the development of better systems and procedures for approaching the decisions in resource allocation and, as much as any other, underlies the introduction of PPBS.

2. If science complicates the tasks of the Board, it also offers assistance through improved means of handling and analyzing information, and in logical processes for the making of decisions. The Treasury Board has initiated the use of computers and the techniques of systems analysis in its operations, and an increasing use of these science-based tools is planned for the future.

APPENDIX A

**EXTRACT FROM THE FINANCIAL
ADMINISTRATION ACT**

PART I.

ORGANIZATION.

Treasury Board.

*3. (1) There shall be a committee of the Queen's Privy Council for Canada called the Treasury Board over which the President of the Treasury Board appointed by Commission under the Great Seal of Canada shall preside.

Treasury Board.
Rep. and new. 1966-67, c. 25, s. 32 (1).

(2) The committee constituting the Treasury Board shall, in addition to the President of the Treasury Board, consist of the Minister of Finance and four other members of the Queen's Privy Council for Canada who may be nominated from time to time by the Governor in Council.

Composition of Committee.
Rep. and new. 1966-67, c. 25, s. 32 (1).

(3) The Governor in Council may nominate such additional members of the Queen's Privy Council for Canada as he sees fit to be alternates to serve in the place of members of the Treasury Board.

Alternate members.
Rep. and new. 1966-67, c. 25, s. 32 (1).

(4) Subject to this Act and any directions of the Governor in Council, the Treasury Board may determine its own rules and procedures.

Rules and procedures.
Rep. and new. 1966-67, c. 25, s. 32 (1).

*4. (1) The President of the Treasury Board holds office during pleasure and shall preside over meetings of the Board and shall in the intervals between meetings of the Board exercise or perform such of the powers, duties or functions of the Board as the Board may, with the approval of the Governor in Council, determine.

Duties of President.
Rep. and new. 1966-67, c. 25, s. 32 (1).

(2) The Governor in Council may appoint an officer called the Secretary of the Treasury Board to hold office during pleasure and to perform such duties and functions as may be assigned to him by the Treasury Board, and the Secretary of the Treasury Board shall rank as and have all the powers of a deputy head of a department.

Secretary of the Treasury Board.
Rep. and new. 1966-67, c. 25, s. 32 (1).

(3) Such other officers and employees as are necessary for the proper conduct of the business of the Treasury Board shall be appointed in the manner authorized by law.

Officers and employees.
Rep. and new. 1966-67, c. 25, s. 32 (1).

* NOTE: Proclaimed in force October 1, 1966. (Can. Gaz. Pt. II, Vol. 100, No. 19).

Responsi-
bilities of
Treasury
Board.
Rep. and
new. 1966-67.
c. 74, s. 1.

*5. The Treasury Board may act for the Queen's Privy Council for Canada on all matters relating to

- (a) general administrative policy in the public service;
- (b) the organization of the public service or any portion thereof, and the determination and control of establishments therein;
- (c) financial management, including estimates, expenditures, financial commitments, accounts, charges for services, rentals, licences, leases, revenues from the disposition of property, and procedures by which departments manage, record and account for revenues received or receivable from any source whatever;
- (d) the review of annual and longer term expenditure plans and programs of the various departments of Government, and the determination of priorities with respect thereto;
- (e) personnel management in the public service, including the determination of terms and conditions of employment of persons employed therein; and
- (f) such other matters as may be referred to it by the Governor in Council.

Authority
under other
Acts.
Rep. and
new. 1966-67.
c. 74, s. 1.

(2) The Treasury Board is authorized to exercise the powers, other than powers of appointment, of the Governor in Council under

- (a) the *Public Service Superannuation Act*;
- (b) the *Canadian Forces Superannuation Act*;
- (c) the *Defence Services Pension Continuation Act*;
- (d) Parts I and II of the *Royal Canadian Mounted Police Superannuation Act*;
- (e) Parts II, III and IV of the *Royal Canadian Mounted Police Pension Continuation Act*; and
- (f) such of the provisions of any other Act respecting any matter in relation to which the Treasury Board may act for the Queen's Privy Council for Canada pursuant to subsection (1) as may be specified by the Governor in Council.

Form of
accounts of
Canada.

(3) The Treasury Board may prescribe from time to time the manner and form in which the accounts of Canada and the accounts of the several departments shall be kept, and may direct any person receiving, managing or disbursing public money to keep any books, records or accounts that the Board considers necessary.

Board
subject to
directions
of Governor
in Council.

(4) The Treasury Board in the exercise of its powers under this or any other statute is subject to any direction given to it by the Governor in Council, and the Governor in Council may by order amend or revoke any action of the Board.

*NOTE: Proclaimed in force March 13, 1967. (Can. Gaz. Pt. II, Vol. 101, No. 6).

(5) The Treasury Board may require from any public officer or any agent of Her Majesty any account, return, statement, document, report or information that the Board considers necessary for the due performance of its duties.

Board may
require
production of
documents.
Renumbered
1966-67,
c. 74, s. 2.

*6. Subject to any other Act, the Treasury Board may make regulations

Regulations.
New.
1966-67,
c. 74, s. 2.

- (a) for the purpose of ensuring effective coordination of administrative functions and services among and within departments;
- (b) for the establishment of general administrative standards of performance and respecting the assessment of the performance of portions of the public service in the light of such standards;
- (c) respecting the collection, management and administration of, and the accounting for, public money;
- (d) respecting the keeping of records of property of Her Majesty; and
- (e) for any other purpose necessary for the efficient administration of the public service.

*7. (1) Subject to the provisions of any enactment respecting the powers and functions of a separate employer but notwithstanding any other provision contained in any enactment, the Treasury Board may, in the exercise of its responsibilities in relation to personnel management including its responsibilities in relation to employer and employee relations in the public service, and without limiting the generality of sections 5 and 6,

Powers and
functions of
Treasury
Board in
relation to
personnel
management.
Rep. and
new. 1966-67
c. 74, s. 3.

- (a) determine the manpower requirements of the public service and provide for the allocation and effective utilization of manpower resources within the public service;
- (b) determine requirements for the training and development of personnel in the public service and fix the terms on which such training and development may be carried out;
- (c) provide for the classification of positions and employees in the public service;
- (d) determine and regulate the pay to which persons employed in the public service are entitled for services rendered, the hours of work and leave of such persons and any matters related thereto;
- (e) provide for the awards that may be made to persons employed in the public service for outstanding performance of their duties, for other meritorious achievement in relation to those duties and for inventions or practical suggestions for improvements;

*Note: Proclaimed in force March 13, 1967. (Can. Gaz Pt. II, Vol. 101, No. 6).

- (f) establish standards of discipline in the public service and prescribe the financial and other penalties, including suspension and discharge, that may be applied for breaches of discipline or misconduct, and the circumstances and manner in which and the authority by which or whom those penalties may be applied or may be varied or rescinded in whole or in part;
- (g) establish and provide for the application of standards governing physical working conditions of, and for the health and safety of, persons employed in the public service;
- (h) determine and regulate the payments that may be made to persons employed in the public service by way of reimbursement for travelling or other expenses and by way of allowances in respect of expenses and conditions arising out of their employment; and
- (i) provide for such other matters, including terms and conditions of employment not otherwise specifically provided for in this subsection, as the Treasury Board considers necessary for effective personnel management in the public service.

Authoriza-
tion of
deputy head,
etc. to
exercise
powers and
functions of
Board.
New.
1966-67,
c. 74, s. 3.

(2) The Treasury Board may authorize the deputy head of a department or the chief executive officer of any portion of the public service to exercise and perform, in such manner and subject to such terms and conditions as the Treasury Board directs, any of the powers and functions of the Treasury Board in relation to personnel management in the public service and may, from time to time as it sees fit, revise or rescind and reinstate the authority so granted.

Authoriza-
tion to
exercise
powers and
functions of
Board re
separate
employers.
New.
1966-67,
c. 74, s. 3.

(3) The Governor in Council may, in respect of any portion of the public service that is a separate employer, authorize the responsible Minister of the Crown, his deputy or the chief executive officer thereof to exercise and perform, in such manner and subject to such terms and conditions as the Governor in Council directs, any of the powers and functions of the Governor in Council or the Treasury Board in relation to personnel management in that portion of the public service and may, from time to time as he sees fit, revise or rescind and reinstate the authority so granted.

Delegation
of
authoriza-
tion.
New.
1966-67,
c. 74, s. 3.

(4) Any person authorized pursuant to subsection (2) or (3) to exercise and perform any of the powers and functions of the Governor in Council or the Treasury Board may, subject to and in accordance with the authorization given to him, authorize one or more persons under his jurisdiction to exercise or perform any such power or function.

Reference
to *Civil
Service Act*
and other
Acts.

(5) Where in any enactment there is a reference to the *Civil Service Act* or to any other Act in relation to any matter that may be determined, fixed, provided for, regulated or established under subsection (1), the reference shall, except as regards any

transaction, matter or thing anterior to the time of the coming New.
 into force of this section, be construed as a reference to this 1966-67,
 Act. c. 74, s. 3.

(6) The powers and functions of the Treasury Board in Limitation
 relation to any of the matters specified in subsection (1) do not in powers
 extend to any such matter that is expressly determined, fixed, and functions
 provided for, regulated or established by any Act otherwise than of Board in
 by the conferring of powers or functions in relation thereto on relation to
 any authority or person specified in such Act, and do not include matters
 or extend to any power or function specifically conferred on, or expressly
 any process of personnel selection required or authorized to be determined.
 employed by, the Public Service Commission by or under the New.
 authority of the *Public Service Employment Act*. 1966-67,
 c. 74, s. 3.

(7) Nothing in this or any other Act shall be construed to Right or
 limit or affect the right or power of the Governor in Council, in power of
 the interest of the safety or security of Canada or any state Governor in
 allied or associated with Canada, to suspend any person em Council not
 ployed in the public service or, after an inquiry conducted in affected.
 accordance with regulations of the Governor in Council by a New.
 person appointed by the Governor in Council at which the person 1966-67,
 concerned has been given an opportunity of being heard, to dis- c. 74, s. 3.
 miss any such person.

(8) For the purposes of subsection (7), any order made Order to be
 by the Governor in Council is conclusive proof of the matters conclusive
 stated therein in relation to the suspension or dismissal of proof.
 any person in the interest of the safety or security of Canada New.
 or any state allied or associated with Canada. 1966-67,
 c. 74, s. 3.

(9) In this section,

- (a) "enactment" includes a regulation, order or other Definition
 instrument made under the authority of an Act; of certain
 expressions.
 New.
 (b) "public service" has the meaning given the expression 1966-67,
 "Public Service" in the *Public Service Staff Relations* c. 74, s. 3.
Act, and includes any portion of the public service of
 Canada designated by the Governor in Council as part
 of the public service for the purposes of this section;
 and
 (c) "separate employer" means a separate employer within
 the meaning of the *Public Service Staff Relations Act*.

APPENDIX B

ORGANIZATION CHARTS

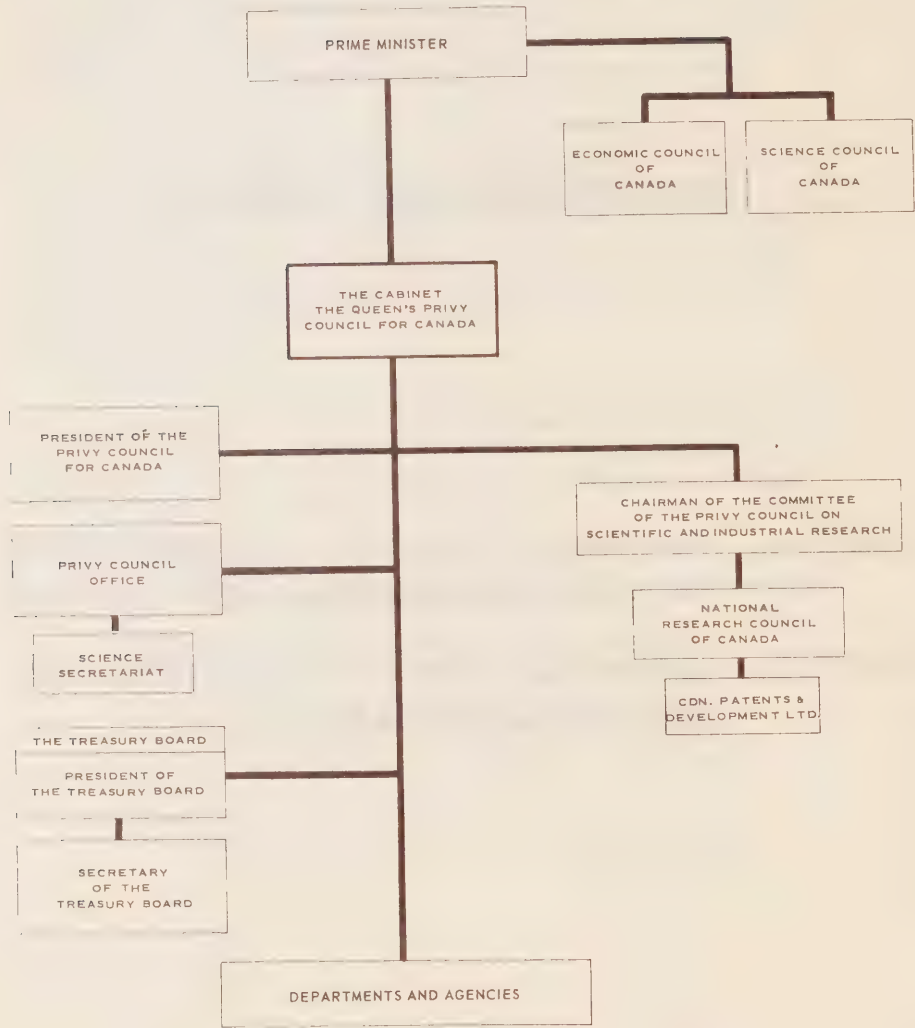
**PART 1 — ORGANIZATION OF THE EXECUTIVE
OF THE GOVERNMENT OF CANADA**

**PART 2 — ORGANIZATION OF THE TREASURY
BOARD SECRETARIAT**



THE EXECUTIVE
OF
THE GOVERNMENT OF CANADA

Note:
Only the offices of the Executive
having an interest in scientific and
technological matters are included
in this chart.



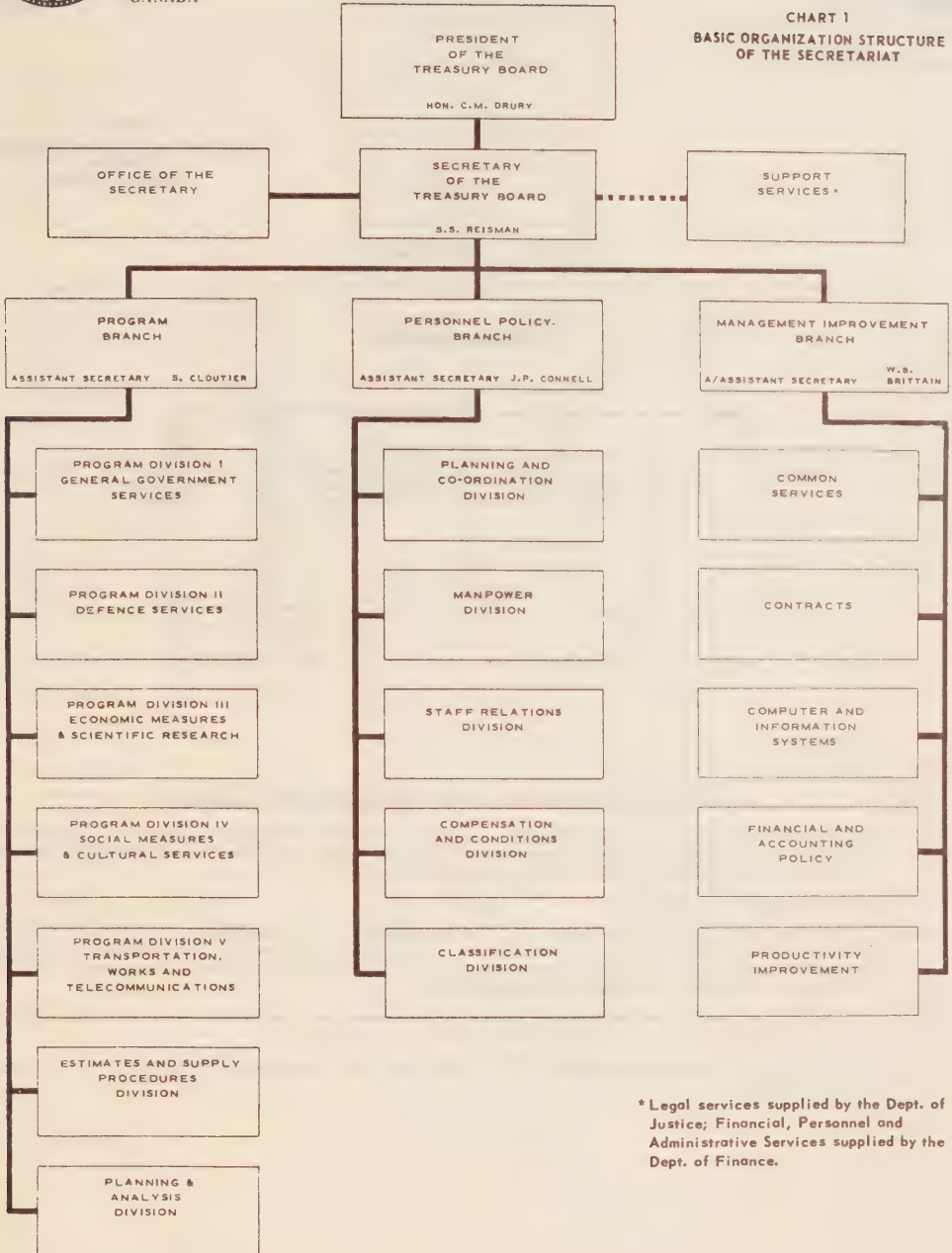
APPENDIX B
PART 2



TREASURY BOARD SECRETARIAT

CANADA

CHART 1
BASIC ORGANIZATION STRUCTURE
OF THE SECRETARIAT



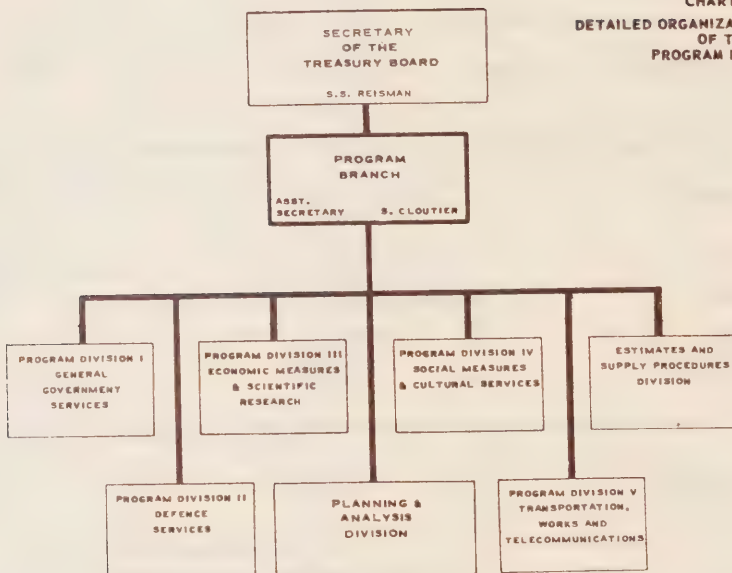
* Legal services supplied by the Dept. of Justice; Financial, Personnel and Administrative Services supplied by the Dept. of Finance.



**TREASURY BOARD SECRETARIAT
PROGRAM BRANCH**

CANADA

**CHART 2
DETAILED ORGANIZATION STRUCTURE
OF THE
PROGRAM BRANCH**

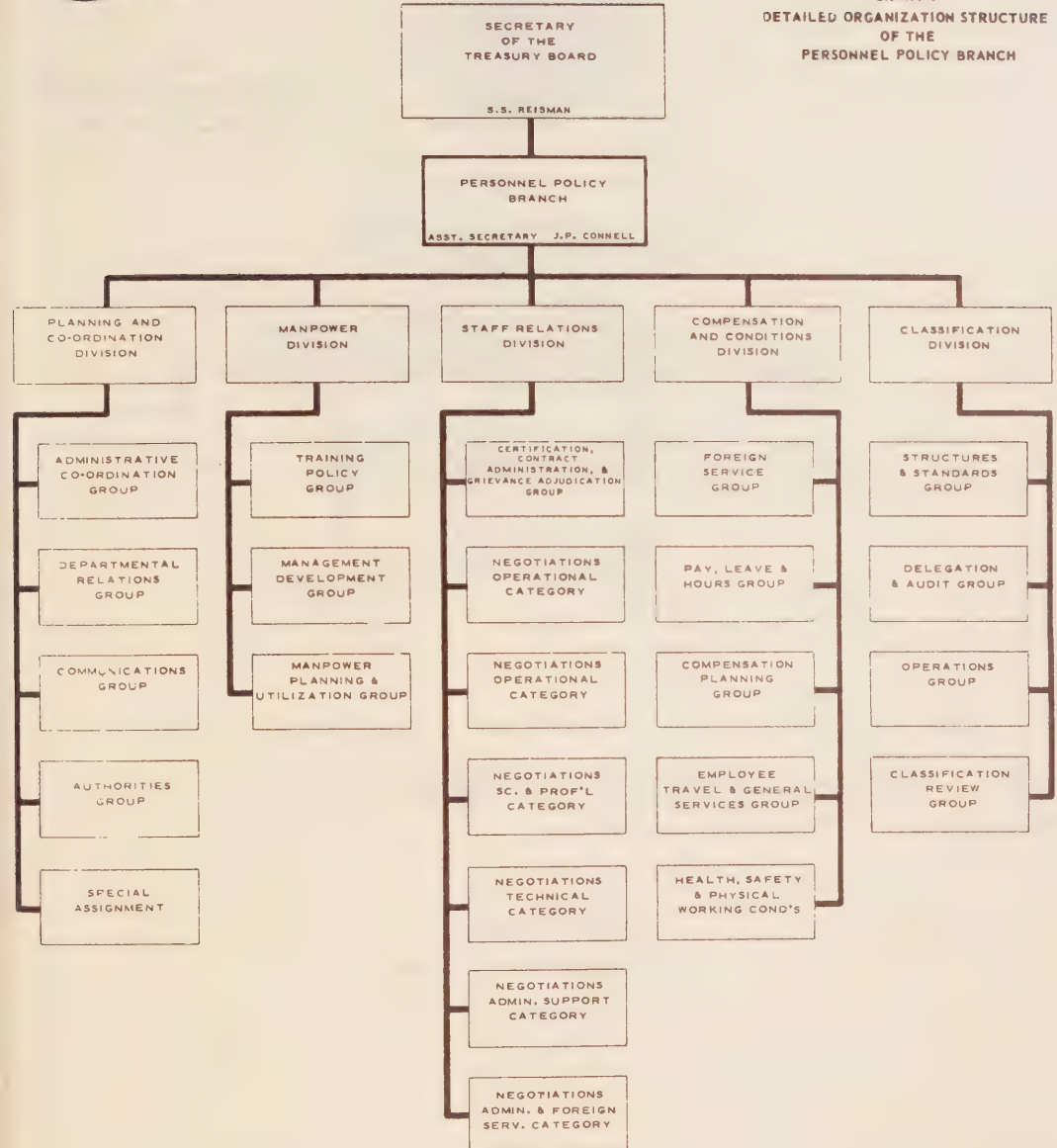


DIVISIONAL RESPONSIBILITY FOR DEPARTMENTS & AGENCIES

- DIV I** - Aud Gen, Can Arsenal, Can Com Corp, Ch Elec O, C of T, CADC, Cons & Corp Affs, DDP, Ex Cr Ins Corp, Ext Aff, Ext Aid O, Finance, Gov Gen & Lt Govs, Insurance, Justice, Legislation, Mun Dev & Loan Bd, Nat Rev, Polymer Corp, PCO & R Comms, PP&S, PSC, PSSRB, Ref Comm, R C Mint, Sol Gen (incl Corr Serv & RCMP), Tariff Bd, Tax App Bd, T & C, Treasury Bd.
- DIV II** - Def Const Ltd, Def Res Bd, EMO, Nat Def,
- DIV III** - Agr, ADB, Atom En Cont Bd, Atom En of Can, Can Pat & Dev, DBS, Dom Coal Bd, Eco Coun, Eldorado Av, Eldorado Min & Ref, Energy Mines & Res, Farm Cr Corp, Fisheries, Fish Res Bd, Forestry & Rural Dev, Indian Aff & North Dev (ND&P), Industry, Int Jt Comm, Nat Batt Comm, Nat En Bd, NRC & Med Res Cou, North Can Power Comm, North Transportation Co, Scientific Secretariat, Can. Dairy Comm, Can Livestock Feed Bd, Cape Breton Dev Corp, Bd of Grain Comm.
- DIV IV** - Can Cou, CBC, Can Film Dev Corp, Imm Appeal Bd, Indian & Esk Affs, Labour, Man & Imm, Nat Arts Centre, NFB, NH & W, Nat Museums of Can Corp, Pub Archives & Nat Lib, Sec of State, UIC, Vet Affs, Co of Young Cdns.
- DIV V** - Air Canada, Can Trans Comm, CNR, Can Overseas Tel Corp, CMHC, NCC, NHB, Post Office, Pub Works, St Law Seaway Auth, Seaway Inter Bridge Corp, Transport.

APPENDIX B
PART 2TREASURY BOARD SECRETARIAT
PERSONNEL POLICY BRANCH

CANADA

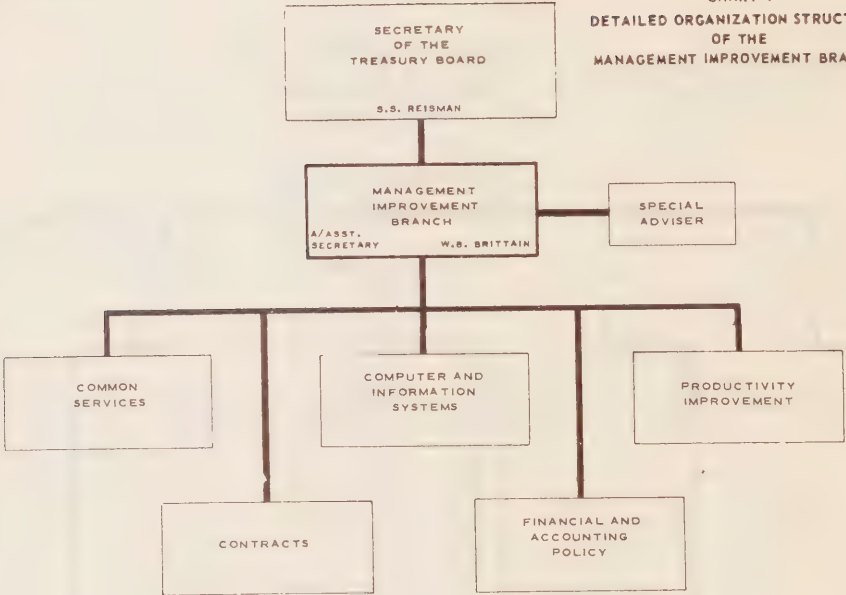
CHART 3
DETAILED ORGANIZATION STRUCTURE
OF THE
PERSONNEL POLICY BRANCH



TREASURY BOARD SECRETARIAT
MANAGEMENT IMPROVEMENT BRANCH

CANADA

CHART 4
DETAILED ORGANIZATION STRUCTURE
OF THE
MANAGEMENT IMPROVEMENT BRANCH





APPENDIX C

PLANNING
PROGRAMMING
BUDGETING
GUIDE

GOVERNMENT OF CANADA

HONOURABLE C. M. DRURY,

PRESIDENT OF THE TREASURY BOARD,

JULY 1968



PLANNING PROGRAMMING BUDGETING GUIDE

GOVERNMENT OF CANADA

HONOURABLE C. M. DRURY,

PRESIDENT OF THE TREASURY BOARD,

JULY 1968

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INTRODUCTION

- 1 The Treasury Board has taken steps over the past few years to introduce a planning-programming-budgeting approach to resource allocation. This guide describes program budgeting in general and the details of the federal government PPB System under development. The guide is addressed particularly to the senior management of departments and agencies – deputy heads, their immediate assistants, directors general and the like – since it is at their level that program decisions have to be made. The term management, therefore, when used without qualification will always mean senior management.
- 2 This guide is the third in a series of related Treasury Board publications, the other two being the Financial Management Guide and the Program Review and Estimates Manual. The first was mainly concerned with promoting the effective management of financial resources through improved accounting systems and the latter mainly with the formal procedures to be followed in submitting budgetary proposals to the Treasury Board in a PPB context. Both gave a rudimentary treatment of the concepts of PPB.
- 3 One respect in which a PPB System is greatly different from traditional forms of government budgeting is in its concentration on the results or output and benefits as opposed to just a consideration of the resources required. Intensive study is made of feasible alternative ways of attaining defined objectives with a view to determining the approach which is most likely to achieve the greatest benefit for a given cost or, conversely, the approach by which a given objective will be achieved at minimum cost. A number of techniques have been found useful in such studies and the application of these techniques is properly the work of analysts trained in their use. As will be made clear, however, it is important for managers to have a good understanding of the techniques.
- 4 Much of the guide is, therefore, devoted to describing the techniques and the analytic processes in which they are used. Because the analytic processes can be quite complex, the chapters describing them have had to be made quite technical in their content. However, since it is managers and not analysts to whom the guide is addressed, this guide is not a “how to” manual. In addition, it would be unfortunate if the emphasis necessarily given to techniques of analysis were to create the impression that analysis is being presented here as a substitute for managerial judgment and that the application of the techniques leads automatically to the “right” decision. In a PPB System, analysis is expected only to promote better decisions since analysis is likely to bring forward a greater range of alternative courses of action for consideration by management and to make more apparent the probable effects of each course of action.
- 5 The manager remains responsible for the making of decisions. In addition, there are usually considerations bearing on the decisions which it is not possible to include in the analysis. While the analyst will endeavour to ensure that considerations of this kind are brought to the manager’s attention, the weight to be given them in deciding on a course of action is a matter for managerial judgment.

- 6 Other topics discussed in the guide are information systems to assist in the management of a program and in the provision of data for the periodic reassessment of decisions; the kinds of staff needed by departments in implementing a PPB System and factors to be taken into account in deciding on the location of that staff in the organization; the present state of implementation of the government's PPB System; and suggestions as to the steps departments should take in fulfilling their role in the System.
- 7 The adoption of an analytic approach to government decision-making of the kind that underlies planning-programming-budgeting is probably inevitable in a complex society. The minimum needs of shelter, sustenance, internal order and the like having been met, there are innumerable possible ways of improving the quality of life and not all the ways can be pursued at one time because of limited resources. Choices have to be made as to what should be done in the full realization that the choosing to do some things means that resources will be unavailable to do other things. The complexity of the considerations having a bearing on these choices invites the application of all that modern techniques of analysis and of gathering and processing information have to offer.
- 8 It is of the utmost importance that it be understood that the competition for resources extends to *all* the programs of government, even those in which the application of quantitative analysis is most difficult. In these latter instances, the analysis may have to be of a more qualitative kind, concentrating, for instance, on the clarification of objectives and a reasoned exploration of alternatives, on attributing numerical values to such factors as may be measurable, and treating factors that defy numerical expression by at least ranking them according to their importance in assessing the alternatives under review.

CHAPTER 1 – THE PPB PROCESS AND ITS OBJECTIVES

- 1 The concepts common to all planning-programming-budgeting systems are these:
 - (a) the setting of specific objectives;
 - (b) the systematic analysis to clarify objectives and to assess alternative ways of meeting them;
 - (c) the framing of budgetary proposals in terms of programs directed toward the achievement of the objectives;
 - (d) the projection of the costs of these programs a number of years in the future;
 - (e) the formulation of plans of achievement year by year for each program; and
 - (f) an information system for each program to supply data for the monitoring of achievement of program goals and to supply data for the reassessment of the program objectives and the appropriateness of the program itself.
- 2 The elements of the Canadian government PPB System have been developed in harmony with the above general concepts and within the context of total resource allocation. By the latter phrase is meant that there is an explicit recognition that the total resources are limited in terms of the individual and collective demands of departments and that there has to be a setting of priorities by the government itself in the light of which departments can plan and budget.

A Framework for Decision Making

- 3 Program budgeting is primarily concerned with resource allocation within the department. In common with much of the literature on the subject, the succeeding chapters of this guide emphasize the value of PPB to departments in making resource allocation decisions within their own spheres of responsibility.
- 4 However, in the final analysis, the resources to be allocated are those of the government as a whole – not the one million or two billion dollars with which an individual department may be concerned, but the whole ten billion dollars of revenues and borrowings that the government is currently spending. The Treasury Board is adopting PPB as a means to assist in *total* resource allocation. It is important then for departments to have an understanding of the whole framework into which their respective programs will fit.
- 5 The Treasury Board has adopted a functional classification of government expenditures which recognizes that government activity falls into six main areas or functions – General Government; Foreign Affairs; Defence; Economic Measures; Social Measures; and Education, Culture and Recreation. The expenditures involved in Fiscal Transfer Payments to the provinces and in Public Debt are set aside under two special functions. This system has three tiers at the governmental level, function, sub-function and functional program and, to the extent that individual departmental programs fall wholly within one functional program, they form a fourth tier. The individual activities which make up departmental programs should each fall entirely within a functional program and thus make up the fifth tier.

- 6 Appendices A and B illustrate this functional classification. The former itemizes the functions, sub-functions and functional programs. The latter shows a preliminary identification of departmental programs or activities to the functional programs they are apparently related to in the sense that the objectives of the programs and activities appear to be directed to the support of the functional program under which each is listed. The classification is of course not fixed for all time. It will require amendment as the pattern of government expenditures changes. Changes are also likely to occur because, as the concepts and techniques advocated in this guide become familiar and are put to use, new program-activity structures are likely to emerge which will call for a realignment of the functional relationships suggested in Appendix B.
- 7 Ideally there could exist a complete framework for resource allocation, one which begins at the level of the function where only the broad, intuitive, and in the truest sense "political", decisions can and must be made, and which extends down through the various levels of the hierarchy, with cost-benefit analysis exerting a progressively greater influence on resource allocation as the decisions to be taken fall within ever narrowing terms of reference. At each level there would be clearly specified needs to be met, identifiable results or outputs that could meet the needs, and measureable benefits that could be demonstrated.
- 8 Such an ideal state is, of course, not easy to achieve. At the higher levels of decision, it is not possible to rely to any great extent on cost-benefit analysis, in deciding for instance how much should be spent on defence as against social measures. And even after a decision is taken to spend a certain amount on social measures, the subsequent decisions as to what should be allocated to health and the other sub-functions are only comparatively easier.
- 9 Despite the difficulties, however, there must be at least an implicit functional allocation. A case could be made for higher levels of expenditure in almost every area in which the government operates. For example, the defence of Canada could take all the revenues of the Federal government if there were no other demands. The arts, the sciences and education could absorb many more hundreds of millions of dollars. Certain areas of the country contain pockets of poverty that only massive investments can relieve. The ever-growing concentration of the population into cities invites increasing attention to clogged transportation facilities, polluted air and water, and sub-standard housing.

The Setting of Priorities

- 10 It is axiomatic that if next year's resources are to be higher by a certain amount than this year's, expenditures for all purposes taken together can rise by no more than the same amount. And it is intuitively obvious that it would be more beneficial for the increase to be distributed unevenly among functions according to the exigencies of the period under review. In other words, expenditures should increase at a faster rate than average for some functional programs, should remain stable in others, and should actually be reduced in still others to free funds for higher priority purposes. Consequently, not only should departmental programs be viewed as competing with one another for a share of the total resources; each program should be viewed as competing with all other programs, belonging to the same or other departments.

- 11 A major element of the PPB System will therefore involve seeking the government's guidance as to priorities to be served in allocating resources. This guidance will be sought in the light of forecasts by the Department of Finance as to the magnitude of the funds likely to be available for the next few years according to specific assumptions as to the rate of growth in the economy, tax rates, and the appropriate level of borrowing for budgetary and non-budgetary expenditures – subject of course to any overriding considerations as to the fiscal stance necessary to correct any imbalance in the economy.
- 12 The recommendations as to priorities will be based on analysis made of information drawn from various sources, and in particular from departmental Program Review Submissions, since these are expected to develop in the quality of their content until they provide by far the best single picture of the needs of the country in federal areas of responsibility.
- 13 Expenditure guidelines reflecting the scale of priorities established by Cabinet will be communicated to deputy heads as soon as possible in the period during which departments prepare their Program Review Submissions. In those functional areas where the guidelines tend to be more restrictive, they should not be interpreted in any sense as ceilings that may not be breached. The Treasury Board Secretariat does not have and cannot have a sufficiently intimate knowledge of the inescapable commitments that departments must meet or the benefits a more current analysis may show are expected to result from new programs or from the expansion of existing programs. But in cases where the guidelines suggest restricted expansion or contraction in program size, the departments concerned have the advantages of an early notice that their arguments will have to be more than usually convincing and of an opportunity to reassess their own priorities and to consider internal priorities among activities.
- 14 At the same time, in those functional areas for which the guidelines suggest expansion will be favoured, no automatic acceptance by the Treasury Board of any particular budget level should be expected. Firstly, there are in many cases two or more departments responsible for operations in any one functional area and the distribution of resources among the departments concerned will depend on the relative benefits forecast. Secondly, even for those functional areas the guidelines might favour, the available new resources will certainly be inadequate to permit the realization of all plans, however meritorious.

Internal Departmental Priorities

- 15 A third element in the PPB System is an insistence that departments investigate and make explicit in their Program Review Submissions the scale of priorities they recommend for each program in the next fiscal year. That is, as explained in more detail in the Program Review and Estimates Manual, departments are requested to show what they consider most urgent or beneficial to be done within each activity and as between activities in the same program. The Treasury Board will take these priorities into account in reaching a balance between resources and demands upon these resources.
- 16 This consideration of internal priorities is expected to extend to recommending the elimination of existing activities whose continuance appears to provide a benefit insufficient to justify the funds required or whose elimination would release funds for relatively more beneficial purposes.

Support Programs and Activities

- 17 Some programs and activities of the government exist to provide service to other programs and activities and in fact some entire agencies exist for this purpose alone. Some of the literature on planning, programming and budgeting argues the thesis that only those operations providing a direct service to the public should be recognized as elements of program-activity structures, that the costs of support operations should be distributed to those programs providing a direct service and, as it were, the support operations should not appear in the budget.
- 18 The Federal government PPB System is *not* being developed in accordance with this thesis. Support operations, either those of entirely common service agencies or those which are found in departments or agencies having other operations providing a direct service to the public, may at this time be accepted as programs or activities and as such may appear in the budget in the usual way: i.e. the more detailed suggestions about program-activity structures found in Chapter 2 will apply. Some methods of relating the cost of administrative and support activities to operating programs are briefly discussed in Appendix C. Future experience may indeed indicate that support operations should disappear from the budget but at this time the advantages of that approach do not appear to outweigh the difficulties.
- 19 The foregoing discussion is of course not intended in any way to prejudice any decisions about the merits of charging for common services: this might still be done whether or not the operations providing the common service are treated as programs and activities.

Systems Analysis

- 20 The term systems analysis is taken in this guide to include the whole analytic process of clarifying objectives, the defining of appropriate program-activity structures for the achievement of objectives and, in particular cost-benefit analysis. These three topics are covered in other chapters of the guide.
- 21 A basic assumption of the Canadian PPB System is that systems analysis is essential to the implementation and success of the System. Departments will be encouraged to set up small staff groups of analysts in a close relationship to the deputy head and his program directors. The Treasury Board will give the lead in the application of analysis. A new section in the Board's Secretariat has been staffed with a number of officers with professional qualifications and experience in the analytic disciplines. In addition to providing advice to the Secretariat of the Board, these officers will design training courses for departmental personnel and will be available for consultation with their opposite numbers in departments.

CHAPTER 2 – OBJECTIVES AND PROGRAM-ACTIVITY STRUCTURES

- 1 A distinguishing characteristic of PPB is the reliance placed on analysis at all stages: at the stage of setting objectives, in evaluating alternative ways of achieving objectives, during detailed planning to put in train the selected alternative, and during implementation to maintain control over progress. The analytic techniques used are not new but are borrowed from other disciplines and employed together in a PPB system to contribute to improved decision making.
- 2 It is convenient to explain the process called systems analysis* under the three topic headings: the clarifying of objectives, the design of program-activity structures, and cost-benefit analysis. These are the three steps in the analytic discipline which should precede and continue to support program budgeting implementation and they are in fact taken in the general order stated. Each “step”, however, is unlikely to be taken just once but may recur a number of times. Tentative objectives are proposed and from these a set of potential programs are inferred. A first cost-benefit analysis is undertaken and this is likely to suggest the reconsideration of the potential objectives and their associated programs. These restated objectives would be expected to lead to more likely programs but further cost-benefit analysis may indicate the wisdom of a second reconsideration of objectives and programs. Since the process is intended to provide a basis for action and is not carried on for its own sake, it must, of course, be suspended at some point. The essential idea to be grasped is the iterative and integrated character of systems analysis, even though for expository reasons the three main divisions of the analysis are presented separately here.

The Clarifying of Objectives

- 3 As was said in Chapter 1, the government exists to discharge certain functions and each department in turn exists to contribute towards one or more of these functions. The first step in the implementation of program budgeting from a departmental point of view is the formulation of a statement of objectives which indicates which function or functions of government the department exists to support and what specific contributions the department makes or proposes to make. The statement of objectives is, therefore, fundamental in that the particular structure which evolves will be directly dependent on the objectives and the way in which they are stated. Successful planning is critically dependent on the clarity of objectives at all levels – governmental, departmental and the levels of departmental program, activities and sub-activities or projects carried on within the scope of each activity. In this guide departmental and program objectives only will be discussed but the considerations raised are equally applicable at lower levels of the structure.

* In some of the literature on PPB, the terms systems analysis, cost-benefit analysis, cost-effectiveness analysis and cost-utility analysis are used interchangeably though some writers have attempted to draw fine distinction between the various terms. “Systems analysis” is used here to refer to the whole analytic process including the clarification of objectives and the defining of programs and activities. In particular, systems analysis will include cost-benefit analysis. The terms, cost-effectiveness analysis and cost-utility analysis will not be used.

- 4 For each departmental program it is desirable to have a statement of objectives which meets the following criteria:
 - (a) the objectives of a program should be compatible with each other;
 - (b) they should be directly translatable to explicit benefits, preferably to benefits that can be measured quantitatively;
 - (c) they should be stated in a way to encourage the consideration of a number of different yet feasible alternative activities, i.e., the objective should not define the method;
 - (d) they should be defined with enough precision to permit identification of any activity within a program which does not contribute to the objectives of that program; and
 - (e) they should be consistent with the department's role as set out in the legislation governing its operations.

The Process of Defining Program Objectives

- 5 There should be a short statement of the department's objectives which describes what part of the total government responsibility the department takes to be its particular responsibility.* Similarly, it is necessary to develop a series of sub-objectives leading to the division of the department's total responsibility into logically separate parts. When such a set of sub-objectives is finally decided upon, each sub-objective corresponds to a potential program.
- 6 It may be helpful to offer an illustration on the process as it has been explained to this point. The illustration is purely hypothetical and although it involves the subject matter of the Department of Agriculture, it does not necessarily represent the ideas of the Department of Agriculture. Suppose that a short statement of the Department of Agriculture's objectives ran as follows:

"To increase food production for domestic consumption and export and to promote the economic welfare of those engaged in farming in Canada." This statement appears generally consistent with the fifth criterion but it quite evidently is of too general a nature to meet the other criteria. The general departmental objective so stated might be clarified along the following lines into sub-objectives. (The names of possible programs the sub-objectives would suggest are shown in brackets after the sub-objectives.)

 - (i) To determine methods of increasing productivity (Research);
 - (ii) To stimulate consumption in Canada of Canadian grown agricultural products (Domestic Marketing);
 - (iii) To enlarge overseas markets (Foreign Marketing);

* In some departments there are certain operations which it carries for good administrative reasons, but which are not consistent with its general responsibilities. The Post Office, for instance, sells Wild Life Permits & Unemployment Insurance Stamps. Such minor responsibilities do not need to be stated or even implied in the statement of departmental objectives.

- (iv) To eliminate or control insects, pests and diseases (Production and Quality Protection);
- (v) To ease the farmer's disabilities arising from fluctuations in foreign markets and variations in production due to climatic conditions (Price Maintenance).

7 Analytic effort is then addressed to the activities of the department and the objectives of the activities are determined. Each activity is identified with the potential program the activity appears to serve and at the same time, preliminary consideration can be given to new activities, consistent with the departmental and program objectives. This could be either wholly additional new activities or new activities that would be preferable substitutes for some current activities. The consideration of new activities should proceed initially with minimum restraint in order that management may be given the opportunity to explore a wide range of alternatives.

The Purpose and Desirable Attributes of Activities

- 8 A departmental program, or more briefly in this context, a program, is a group of departmental activities, all of which are directed to the achievement of the objective or set of objectives of a departmental program. The activities grouped are usually alternative or complementary means for achieving the objective or set of objectives and, therefore, the activities concerned should be considered together when major choices are made about the allocation of resources. There are a number of considerations that should be kept in mind.
- 9 First, the activity structure within a program must be designed to assist resource allocation decisions which are made within the department on the basis of analysis as well as outside the department by Ministers collectively as members of the Treasury Board and Cabinet. In many cases, the review by Ministers as a group may not go below the program level. However, when questions cannot be resolved at that level, the greater detail offered by activity documents will have to be considered. Ideally, policy and expenditure limits against which all submissions to the Board could be compared would be established by Ministers of the Board for each program, and by implication for each activity. Submissions clearly in accord with the agreed policy and expenditure limits would then become routine matters and be processed as such.
- 10 Secondly, the activities of a department are the headings under which the department will negotiate for funds with the Treasury Board, the headings under which requirements can be best explained and the benefits forecast. It will, of course, be necessary to show the interrelationships of activities within a program to provide a clear picture, but when this has been clarified, most of the detailed attention will be given to the activities individually.
- 11 Thirdly, the activities of a department provide the focus for planning by the department in deciding how to achieve program objectives. If a department carries on some large operation in each of several offices across the country, these offices are responsibility centres. But, if the operation no matter where it is carried on is directed to the achievement of one objective or set of objectives, the operation forms the activity. Therefore, the parts of a single activity may be found in more than one responsibility centre and, conversely, one responsibility centre may be concerned in more than one activity.

- 12 Fourthly, in order to avoid having too many activities, each activity should involve the largest set of projects possible as long as the objectives to be served do not become too diverse, since it is desirable that an activity serve one, rather than two or more, objectives.
- 13 Fifthly, in delineating an activity, it is important to remember that for it to be meaningful, the mix of operations should be homogeneous in character. There is a natural tendency to solve accounting problems by choosing an activity structure that is identical to the responsibility structure despite the fact that the activities thus become a heterogeneous collection of operations. If this is done, discussions between the departments and the Treasury Board will tend to fall to the level of objects of expenditure, work volumes, and like details and the true activities of the department will become obscured in the organizational network. Discussions should be about policy, the objectives to be achieved and the appropriate total resource allocation. These can only be meaningful topics when the whole activity is viewed at once in relation to the program it supports rather than in small segments carried on by various responsibility centres.

Research Activities

- 14 Many programs are supported by research — research being defined as a creative activity which produces some form of innovation. These operations, like all others of government, are encompassed within the PPB resources allocation system.
- 15 If the resources involved are small and the research forms an integral part of a particular activity or departmental program, it will not be necessary to identify the research as a separate activity. Should the research incur large fractions of a department's budget it should be treated as a separate activity or activities. When the whole of the activity of a department is devoted to research, for example the National Research Council, it will be appropriate to submit a program made up of significant research activities.
- 16 Although justification for resource allocation to research activities must be argued in terms of potential benefit related to cost, the Board appreciates that applied research has more direct potential benefits than so-called pure research. Since the support offered by pure research is more diffuse it may have to lean for its justification upon broader benefits which may be associated with the development of national prestige, education, the attraction of trained people to Canada or the counteraction of the brain drain, etc. Applied research which is aimed at supporting specific objectives should include in its justification a clear statement of the particular sector of the Canadian economy it is intended to benefit.

Treasury Board Approval

- 17 Because the programs and activities of departments are key elements in the processes of analysis and resource allocation, the program-activity structure of departments will require approval by the Treasury Board, such approval to be sought in a specific submission to the Board. A well-defined program can very much simplify the Board's task in making allocation decisions and the department's task in long-range planning. A well-defined program in this sense is one in which the objectives are clearly stated and identify measureable benefits; in which the activities comprising the program are shown

to clearly serve the program objectives; and for which a reporting system has been devised to show at suitable intervals the progress being made in achieving objectives. In such a situation, it should be possible for the Board to consider a long-term commitment of resources, to be honored in all but very abnormal budgetary situations.

- 18 While, as was said, each program-activity structure will require Board approval, that approval will not necessarily be withheld in any particular case in which the structure is not well defined in the sense of the preceding paragraph. The collection of activities a department puts together to make up a program may require a resource allocation even though the collection does not fulfill the requirements set forth for a satisfactory program-activity structure. But such allocations will tend to be made on a year-to-year basis, following searching examination and will be subject to continuing review. It would not be surprising, however, if such a department, seeking funds for expansion, should find itself at a competitive disadvantage with another department able to justify its request for funds in terms of objectives and presenting its justification in terms of a well defined program-activity structure.

Program-Activity Structure, Objectives and the Estimates

- 19 The Treasury Board has approved a new form of the Estimates to be introduced for the fiscal year 1970-71. This new form will present departmental estimates in terms of programs and activities and will record the objectives which the programs and activities are meant to serve. For this reason, as well as for their vital significance in planning and implementation, the clarity of objectives is of great importance.
- 20 In the long term, it is intended that the appropriation structure match the program structure with each departmental program being financed by one vote. Considerations of parliamentary control may sometimes dictate the necessity for sub-votes related to activities or major elements of activity (such a large scale transfer payments) but the equating of the vote structure and the program structure should make more evident to Parliament the intended relationship between appropriations and results.

CHAPTER 3 – COST BENEFIT ANALYSIS

- 1 The purpose of this chapter is to provide the manager with an appreciation of cost-benefit analysis and how it may serve him in his role as senior manager. To summarize the entire process, the following six steps describe the operations which should be performed if the manager is to be able to make use of the analytical data. Thus after the program objectives are agreed the analyst should
 - (a) List and describe alternative ways of achieving objectives.
 - (b) Enumerate the principal benefits expected and the sources of costs.
 - (c) Devise appropriate measures, preferably in dollar terms, for these costs and benefits.
 - (d) Construct mathematical models for experimenting with the proposed alternatives. This involves:
 - (i) obtaining an understanding of how each proposed alternative will function.
 - (ii) identifying the key variables and the variables that can be neglected;
 - (iii) establishing the relationship between the key variables; and
 - (iv) gathering the data necessary to use the models in testing alternatives under various assumptions.
 - (e) Determine the costs of each alternative and place a value on the benefits produced by each alternative.
 - (f) Decide on decision criteria for ranking the alternatives.
- 2 Since the whole reason for the analytic effort in program budgeting is to assist the manager in decision making, the relationship of the cost-benefit analyst to the manager is not the usual one of expert to customer. The manager should not look upon the analyst as an expert who supplies advice which the manager can accept or reject. As will be brought out here, the analyst must have frequent communication with the manager before and during the decision-making process to ensure that the latter's judgement on many matters is reflected in the analysis. Leaving aside the technical knowledge and training insight the analyst is expected to have, he becomes an extension of the manager carrying out a task the manager would do himself given the time.
- 3 The manager thus needs to be aware of the principles that will guide the analyst, the conventional steps he will take and the meaning of at least some of the common terms. In Appendix D a simple example is presented of a classical application of cost-benefit analysis reduced to its bare essentials. The subject matter of this example is used to describe the methodology and to show the meaning of technical terms and it will show that even in the areas of classical application, the problems of analysis are complicated by "spillover" effects, that is indirect costs and benefits which arise because the project under analysis cannot be isolated in its effects from the rest of the world.
- 4 It must be admitted that some projects may be extremely difficult to quantify but it can be argued that the very process of "stepping through" the analysis will be of great value to the decision maker. Even if the initial pessimism about the precise nature of the

conclusions reached is justified, the resulting partial analysis will lead to better decisions than no analysis whatever.

- 5 Managers with certain kinds of technical backgrounds will have an advantage in assuming the role spoken of above. They will, at the same time, find this necessarily a cursory treatment of matter with which they are familiar. There is a large body of literature on the subject, most of it dealing with case studies rather than general theory, and a selection from that literature is given in a bibliography at the end of the manual. All managers could, with profit, explore the material in the references provided, but it is hoped that the general treatment given here will make it possible for each manager to see how the techniques of cost-benefit analysis will be of assistance to him in reaching decisions.

Clarity of Objectives

- 6 The necessity to be clear about objectives must be brought out here again since, unless the objectives are the "correct" objectives, analysis may be a mere waste of resources and may even mislead. A surprising amount of the literature on cost-benefit analysis is concerned with the inadequacy of the method. Most of the criticisms made can be subsumed under the one criticism that the analyst or the manager, or more probably both, were not clear about objectives at the inception of the analysis and that the analytic process itself did not correct the deficiency.
- 7 The classical applications of cost-benefit analysis have been in the evaluation of plans for defence hardware and public investment in water resource projects. The example worked through in outline in Appendix D deals with an analysis of two alternative methods of carrying through a hydro-electric project. It will be immediately seen that the objective, as stated, has already assumed that the method of power generation would be by hydro and, while this may be valid in an example, in real life it would be necessary to assess these proposed solutions against the possibility of using fossil fuels or nuclear energy in a thermal power plant.

Discounting

- 8 In analysing any number of projects it is evident that neither the expenditures nor the benefits are likely to occur at precisely the same instant in time but instead there is likely to be a COST TIME STREAM and a BENEFIT TIME STREAM stretching some years into the future. A typical example might look like the curves illustrated in the figure and it is obviously necessary that values arising at different times be adjusted to some common base for comparison. Such an adjustment must recognize that costs which are incurred now are more onerous than future costs and, at the same time, benefits to be enjoyed now are more valuable than benefits to be enjoyed later. This adjustment is made by bringing all future values of costs and benefits to their PRESENT VALUE by some discount rate related to the cost of borrowing funds for the long term. The choice of the appropriate rates of interest to be used is discussed in more detail in paragraph 11.

Uncertainty

- 9 Future benefits can of course seldom be known exactly, whether it is growth in usage of National Parks, employment of adult trainees or demand for electric power. However, in

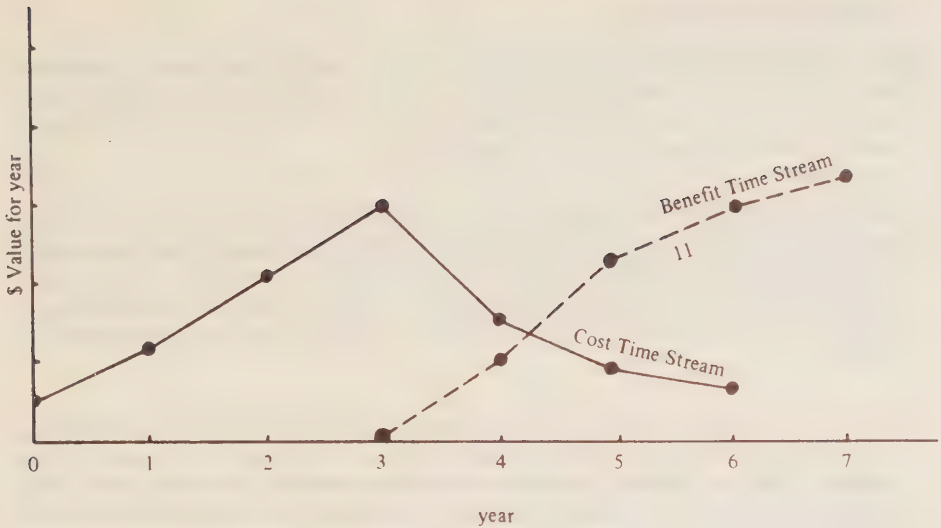


Fig 1

most instances the manager can estimate a range of values from most pessimistic to most likely to most optimistic. This is his range of **UNCERTAINTY** and must be differentiated from **RISK**, which is the probability of something not occurring at all

- 10 If variables in the analysis can assume a range of values, it is important to see how this uncertainty affects the overall value of all the alternatives. Suppose in a hydro-electric study there is some uncertainty about the future demand for power and there is a change in the order of preference of the projects depending on the power demand. If one of the projects is capable of incremental development, it may be possible to tailor its size to match future demands for power and this would make the net benefit less **SENSITIVE** to future demand than a project which can only be built in one size.

Discount Rates

- 11 In the discussion of present value, mention was made of the difficulty in choosing an appropriate discount rate. The rate at which the federal government can borrow money is not the only rate at which to discount costs and benefits for a government project. Ideally the rate should also take account of **OPPORTUNITY COSTS** of funds, that is the return they might yield in alternative uses, even the most favourable possible yields in the private sector. Pragmatically, the solution to the problem is to apply a standard set of rates of discount, taking as a lower limit an approximation to the long term government rate for borrowing and as an upper limit some arbitrary, higher rate. Specifically the rates to be used will be first the three rates 5, 10, and 15%. Should it transpire that the ranking of alternatives is insensitive, that is remains unchanged, when these three different rates are used, it is unnecessary to proceed further in this aspect of the analysis. Should it be determined that the ranking changes or the project reaches a breakeven point within one of the two intervals, 5 to 10% and 10 to 15%, the critical rate at which this occurs should be made known in the report of the analysis.

Benefits and Their Measures

- 12 Most case studies in the literature tend to be over simplified and some of the most significant problems normally encountered in cost-benefit analysis are skated over lightly. There are the problems of indirect costs, indirect benefits and placing a monetary or other value on both costs and benefits.
- 13 Any program or activity which is undertaken will probably have more than one identifiable benefit or source of costs. A major hydro-electric power dam may provide the additional benefit of flood control but at the same time valuable farm land may be lost. At a secondary level the project may create a lake for water skiing and swimming while at the same time destroying marshlands valuable for wild fowl and streams for fishing.
- 14 A further interesting example which can be cited to illustrate some of these problems is the adult education program. One common approach in this area is to compare lifetime earnings of people of different standards of education, calculate the present value of this benefit and compare it with the present earnings. Some studies make allowances for changes in rates of unemployment, family and social benefits etc. However, it must be appreciated that unless there are job vacancies for the trainees to move into, they will either still be unemployed or displace someone else. Thus the assessment of benefits is complicated by changes in the pattern of unemployment, which may be a desirable objective in itself, and the multiplier effects of the potential earnings on the economy.
- 15 Ideally, in analysis all sources of costs and benefits, direct and indirect, will be presented in monetary terms. This permits the comparison of projects with widely different end products — for example, the energy generated from a hydro project and the improved transportation facility offered by a new road.
- 16 When a number in monetary terms cannot be attached to an end product, it is often possible to use some other numerical measure in comparing alternatives. Where one of the objectives of a program is to save lives a clearly valid measure of benefit is the number of lives saved. When a program or activity objective can be defined with sufficient precision to express the principal desired output as a single type of “commodity” such as a life, then the number of such units provided by an alternative is a measure of that alternative’s effectiveness. Thus if the choice to be made is between a number of possible alternatives all producing the same output, even if it is intangible, so long as the product or service supplied is both recognized and quantifiable it will serve as a measure for rating the alternatives.
- 17 While this approach may be acceptable within a department or for some of a department’s programs, any manager trying to allocate a given budget among competing programs with diverse outputs may be faced with the problem of INCOMMENSURABLES. That is, the output of each program may be clearly stated and expressed in quantified terms but the different outputs may have no apparent common ground which will permit meaningful comparisons to be made. For example, the output of program A may be the number of lives saved due to health care while the output of program B may be additional years of schooling provided to a particular group in society.

- 18 In such cases every effort must be made to find a common denominator to which all benefits can be reduced. The most useful common denominator is money and the exercise of ingenuity can make this measure applicable in some cases where it might seem unlikely at first glance.
- 19 For an adult training program the output is clearly an increase in skills of persons trained. The objective is economic and the most desirable measure of benefit would be the growth in the national product attributable to the increased level of skills on the part of the work force trained. This is not directly measurable. The measure chosen was the difference between the discounted life time earnings of the trainee's occupation at entry and those of the occupation for which he is trained. This provides an instance of a substitute or PROXY measure.

Models

- 20 In every cost-benefit analysis there will be a mathematical model implied or explicit. A model in this context is a rule or set of rules which establishes the relationships between variables and allows the estimation of benefits and costs involved in an alternative. In the simple illustration of the hydro-electric project, where there is only the one benefit to be considered, i.e., the units of energy produced, the number of units expected would be estimated from the engineering calculations and the measure of benefit derived by applying the price at which it was expected the units of energy could be sold. Similarly the costs would be derived from standard engineering estimating techniques. These engineering techniques are, of course, also models.
- 21 For many problems there will be no standard estimating technique in existence and the analyst will then find it necessary to establish a set of rules for the problem at hand, possibly taking the form of a set of mathematical equations. A complete mathematical formulation of the problem based on accepted theoretical relationships would be ideal. In practice the model is a partial representation of reality which closely duplicates how the proposed alternative will react under different conditions and assumptions. To do this, it must include the key variables which affect the performance of a proposed system both in producing benefits and in incurring costs and will have to express correctly the relationships between these variables. Sometimes the model may best take the form of a simulation employing a computer and such simulations are now being used widely. A Canadian university is using one to study its own administrative problems regarding space requirements, course enrollments, staff loads, etc. Simulation is also used extensively to arrive at optimum mixes in day to day oil refinery operations and has provided a basis for setting a price support policy for the uranium industry.
- 22 The great advantage of a computerized model is that it gives the analyst the capability of running numerous trials and sensitivity analyses to investigate the ranking of many alternatives under a host of assumptions. Where the rules governing the determination of costs and benefits cannot be expressed in mathematical form, either analytically or through simulation, the model may have to consist of a set of rules which expresses in words and numbers the relationship between the variables as these relationships are best understood.

The Need for Data

- 23 As will be evident from several points raised in this chapter, the quality of analysis will depend very much on the quality of the data going into the analysis. When a model is used for sensitivity testing, it is necessary to substitute actual values for the variables. If the model is well structured, it will directly indicate all the information requirements, which may however often not be readily available in an accurate form. The choice must then be made of waiting until data is available through properly designed statistical methods or of substituting estimates based on incomplete data on a temporary basis to obtain preliminary results.
- 24 In carrying out an analysis to decide between competing alternatives, the second is the preferred choice. It is often sufficient for the decision maker's purposes that he be given estimates of the range in which benefits and costs are expected to fall unless the alternatives under study are very close competitors. This does not mean that careless statistical estimation techniques are acceptable, but only that when time is short, the responsibility of the analyst is to do the best he can within the time span allotted and to inform management of the uncertainties associated with his estimates. It is a management decision whether more time and money should be spent on improving the estimates. The analyst can assist in this area by using his model with a sufficiently wide range of variables to help determine which of the variables cause wide fluctuations in system output and to which variables the output is relatively insensitive. Thus any extra effort can be concentrated on improving the knowledge about the more significant variables.
- 25 Once a decision has been made as to the alternative to be adopted, the question of costing takes a new form. The estimates now required must be accurate since they will form the basis of requests for funds in Program Review submissions. Overestimates in costing at this stage will cause diversions from other activities that could have been profitably pursued while underestimates will, at a later stage, lead to diversions from other activities or to unwelcomed reductions in the originally chosen scale.

Benefit-cost Decision Criteria

- 26 A decision to select one alternative from a number is made according to some criterion or criteria. In the simpler situations where all costs and benefits can be expressed in a common unit, which for most purposes is a monetary unit, the alternative chosen will be that providing the greatest net benefit (Net benefit equals Present Value of the Benefit Stream less Present Value of the Cost Stream) or the highest benefit-cost ratio. Where costs can be expressed in dollars and benefits only in some non-monetary terms, the decision can be reached by fixing the budgetary limit and choosing the alternative which maximizes the benefit. Conversely, a minimum acceptable level of benefit can be set and the lowest cost alternative chosen. In an Emergency Measures Program directed to the preservation of life, the number of lives likely to be saved is a most appropriate measure of benefit and it is not necessary in that context to attempt to place a dollar value on the benefit.
- 27 The criterion of the benefit-cost ratio or the greatest net benefit should not be applied mechanically. As the tabular presentation in the hydro dam project illustrates (Appendix D), any alternative that can be undertaken at different scales may have more than one

benefit-cost ratio and more than one value for net-benefits. Thus the choice between alternatives cannot be divorced from questions of the minimum level of benefits considered acceptable or indeed of the total costs that would be required.

Other Decision Criteria

- 28 An alternative may satisfy the objective and have the highest net benefit to cost ratio, and still not be chosen. There are often other constraints having a bearing on the decision. For example, a choice may be subject to consideration of the effect on the balance of payments, the promotion of Canadian industry, the impact on depressed regions, and to the restraint that the activity will have to be operated by personnel presently on strength in the department. If such conditions and restraints are to have a bearing on the decision maker's eventual choice along with the benefits and costs arrived at through the analysis, the analyst should be made aware of them at an early stage so he can furnish information on them to the decision maker. The decision maker should attempt to make clear the weights these additional criteria will have relative to each other and to the primary criterion, the benefit-cost ratio or net benefit.
- 29 There may also be other overriding criteria of which the most common is an upper limit on the total funds available for a project. Knowledge of an overriding criterion permits the analyst to eliminate from consideration at an early stage, and prior to detailed analysis, any alternatives which fail to meet the criterion.

Technical Monographs

- 30 As was indicated at the beginning, the object of this chapter was to convey an appreciation of cost-benefit analysis suitable for the managers and therefore no attempt at rigor or completeness was made. It is planned to remedy this deficiency in a series of technical monographs, directed to technical staffs of departments engaged in program analysis.

CHAPTER 4 – MANAGEMENT CONTROL

- 1 This chapter deals with the subject of control as it relates to the achievement of program objectives. Because control is exercised through information, something will be said about management information systems and general data needs for program budgeting. Each is a topic of much significance in its own right but the treatment given here must, of course, be restricted to what need be said about control and management information systems as they bear upon program budgeting. Each topic will be dealt with in summary form first and then later dealt with separately in more detail.
- 2 Management control consists in taking action to ensure that steps are going forward as planned to achieve the objectives decided upon, it being assumed that there is an operational plan to which progress can be compared at appropriate intervals. Reports produced through a management information system show or permit a comparison of progress to planned achievement. A management information system can as well generate much information for cost-benefit analysis which might lead to adjustments of plans on the basis of better data.
- 3 The chapter will also refer to problems in analysis occasioned by the absence of data and offer some suggestions about circumventing such problems.

Management Control

- 4 The systems analysis process is carried out to arrive at a decision about the course of action to be taken in satisfying specific objectives. Since the course of action is to take place in the future, there must exist uncertainty about its outcome. The manager must then require that an appropriately detailed operational plan be prepared, indicating stages of progress or intermediate goals to be reached towards the attainment of the objectives. From time to time, he will want reports which show a comparison of performance against goals. If the reports show that, in fact, expected performance is not taking place, he will have to decide whether the attainment of objectives is being jeopardized and whether he must shift resources or allow adjustment to the schedule. He may, of course, decide that the difficulties are more fundamental and that the assumptions made in analysis have been disproved to the extent that new analysis is required in the light of better and more current information.

The Types of Control

- 5 There are two kinds of control – one output oriented and the other input oriented – that is, one emphasizing steps taken to promote the achievement of chosen objectives of a program and the other emphasizing expenditure limits that are not to be exceeded or statutes or regulations that are not to be violated. One is achievement control and the other is resource control. Resource control as defined here is well known to government managers. Whatever specific form this type of control may take it is required because:
 - (a) the control by Parliament over votes and over cash appropriated is paramount in our political system;

- (b) some initial or primary segmentation of votes by major levels of responsibility or by activity or the like will be made and some control over the financial and personnel resources allotted to these segments will have to be maintained; and
 - (c) where a contract or some other form of covenant is made that requires payment in the future some record of the commitment is likely to be necessary to avoid over-commitment.
- 6 All these elements of a resource control system can be put in place and meticulously observed without there being provided any assurance that the manager will be made aware of progress in achieving objectives. What is, therefore, needed in addition is a system of achievement controls that will bring to the manager's notice any divergence of a serious nature between actual outputs and planned outputs in each activity.
 - 7 There are now produced for some departments periodic reports showing expenditure by activity and the variance for the month and year-to-date between what was expected to be spent and what has actually been spent. These reports, broken down by some object of expenditure groupings, can sometimes show one or more operations in the activity to be out of control. A large variance must mean that a great deal more money or a great deal less money has been spent than was planned, suggesting underestimation of real needs or achievement of greater progress than had been expected. But reports at the activity level and in money terms only will not answer the manager's requirement to be informed.

The Content of Reports

- 8 What is needed for each operation within each activity is a statement of planned outputs or results for the period against actual outputs and results for the period. While the alternative chosen after analysis may be one which is expected to return the greatest net benefit or which shows the highest benefit cost ratio (subject to the other decision criteria of scale, budgetary limits, etc.), it may not be possible in all cases to devise a reporting system that reveals directly the achievement of benefits in a satisfactorily short period of time. It may be necessary to build control reports around units of input or of intermediate output from which the final outputs or benefits are expected to result. The final outputs or benefits may not be directly measurable in themselves or their achievement may require too long a lapse of time to be meaningful as a reflection of progress during implementation of an alternative. The following examples are meant to illustrate the foregoing points.
- 9 Assume an analysis undertaken to decide on the best way to provide a transportation link between two points. The benefit to be measured is the convenience offered to an expected flow of various kinds of traffic. The alternatives considered may be a new road, an expanded train service, or the re-routing of an airline. Suppose the analysis leads to the conclusion that a new road system is preferred. The operational plan is likely then to take the form of a schedule for the construction of a road. The manager will want reports of how efficiently the road construction is being carried out and how well budgetary limits are being observed. In the course of implementation then, he is able to satisfy himself only as to intermediate outputs and to control resources going into construction but not to satisfy himself that the expected benefits will in fact become manifest.

- 10 It may transpire that when built the road system does not bring anything like the flow of traffic expected and that it is now apparent that a serious overestimate of demand was made. This does not necessarily mean the analysis was invalid on the basis of the information supplied, but it does illustrate the difficulty in some cases of controlling the achievement of benefits. In this first example the costs have been fully incurred before any corrective action could be taken.
- 11 Consider as a second example a decision to open a new trade promotion office in a country where Canada has not previously had representation for this purpose. The decision is taken on the assumption that a 10 per cent increase in our exports to that country will take place. Assume also that it is decided to maintain the representation only if an appreciable improvement in exports is made. The manager in this case will in time receive reports of actual trade volumes and compare them with volumes obtaining prior to the opening of the new office. In this example the benefits can be measured directly but again only after a long time lag. It is therefore necessary in the short term to base the reporting system on some measure of work volume, such as inquiries received from prospective importers and referred to exporters in Canada. In time, if it becomes evident that trade is not developing to the extent that justifies the continuation of the post, the post may be closed before the full costs of the plan have been incurred. In this respect there is a difference between this and the first example.
- 12 In a third example the benefit may be simply an improved service to the public. Suppose that a type of permit had in the past to be obtained by mail at considerable delay and inconvenience and that it is decided to open offices in a few major cities where the permits may be obtained in person directly upon application. The direct measure of benefit is the number of members of the public who use this method of procuring permits and this measure may be reported on daily, weekly or monthly as desired to permit a very prompt evaluation by management of the success of the system.
- 13 The internal administrative services of a department responsible for supplying material or for supplying personnel resources are also often amenable to direct and prompt measurement. Reports on the number of orders for materials or the number of requests for new appointments that remain *unfilled* after a specified and reasonable length of time provide useful negative measures of achievement upon notice of which the manager can take corrective action.
- 14 These examples are meant to illustrate that management control reports need to be custom tailored to the circumstance of each activity, that it may be necessary to settle for measures of intermediate outputs in complex situations rather than measures of the expected benefit. The control reports should also guide the manager to a reassessment of a chosen course of action where there are indications that expected benefits are not being realized.

Management Information Systems

- 15 Probably all departments and agencies as they set out to implement PPB will find they are faced with a lack of information at every turn. They are unlikely to have even clearly stated program objectives. They will almost certainly have insufficient data from which to derive estimates of the costs and benefits of alternatives they will want to analyze. The quality of planning and analysis must, therefore, if for no other reason, fall short of a high level of attainment. Costs will be inaccurate, benefits estimates may be little

better than guesses, criteria for selection between alternatives will lack discrimination, and sensitivity to assumptions will be very high. While the initial problems may be unavoidable, the shortage of information does not provide an acceptable excuse for delay in introducing PPB. There will be *some* kind of data base to be exploited and the systematic application of PPB principles even on a deficient data base is likely to enhance the quality of decision making. The full returns from the PPB system, however, can only be enjoyed after there has been put in operation an information system which provides data to support analysis and control.

- 16 The term management information system has at present a certain vogue and is applied to everything from a simple set of more or less regular typewritten reports to as yet largely speculative data banks into which flow all data about all the events occurring in an organization as the events occur and from which it is possible to obtain on demand a wide variety of pre-analyzed up-to-the-minute reports of the status of organization. These elaborate, instant-response, data banks may come to be seen as necessary and feasible for some government operations. But, for the time being, much advantage can be had from less ambitious plans to use computers where their use is dictated by some combination of large data volumes, the need for pre-analysis and a quick response schedule – the latter being measured in days after the event rather than seconds.
- 17 More specifically, that part of an information flow in a department that is handled by a management information system will be characterized by its being produced regularly (weekly, monthly, quarterly, or annually) in a fixed pattern, in prescribed units, and according to a pre-determined plan whether a computer is employed or not. Much of the information the manager will use in controlling performance will flow from the management information system. And, in addition, the management information system will produce data for the on-going work of program analysis. Its value in this regard can be increased if the system is used purposefully to gather data for analysis which it is intended to conduct in the future. However, any information system, whether designed to do so or not, is likely to add to the analytic data base.
- 18 On the other hand it is uneconomical and unnecessary to burden the management information system with the task of gathering *all* data needed in analysis for a number of reasons. Some data are needed only once or from time to time and can be gathered by special surveys. The data desired may already be available from another department or other source. Where neither of these two ways of satisfying a data need are open, there may exist a serviceable approximation or rough methods may be used in securing such an approximation.
- 19 For instance, if the operations followed in carrying on two activities are intermingled, it will be necessary to estimate the costs attributable to each. But this may have to be done only at long intervals in a static situation. A random sample study of the kind with which work measurement specialists are familiar can quickly supply data of sufficient precision. It is probably unnecessary to trace each dollar. In one office where a distribution of the time spent on each of several kinds of work was wanted, each clerk was supplied with a numbered card for each kind of work. The clerks were instructed to display the appropriate card when engaged in a given kind of work. At selected intervals, a junior work study technician toured the area and recorded on a prepared form the count of cards of each number he saw. Over a two-week period the distribution of work according to kind was known with accuracy and the total clerical costs could be apportioned between the operations.

- 20 Before undertaking the cost of collecting data on some variable, thought should be given to using information already available on some nearly equivalent variable. For example, interprovincial movement of *all* family units may be sufficiently well reflected for many purposes by interprovincial movement of family units in receipt of Family and Youth Allowances. The latter is a readily available statistic. In the Emergency Measures program, already accepted estimates of extra cost for the protection of buildings against earthquakes might also be accepted as estimates of the costs of protecting buildings against blast effects.

CHAPTER 5 – ORGANIZATION AND STAFFING

- 1 Each department and agency, except some of the smaller ones, will be expected by the Treasury Board to have in its organization a unit whose sole responsibility is the analytic work associated with program budgeting. The unit will be referred to here as the program analysis unit. Since there is no single best answer to the question of where the unit should be lodged in the organization, this chapter will attempt to guide rather than prescribe.
- 2 Because of the emphasis placed on PPB being the major decision tool for senior management there well might be an intuitive tendency to require that the chief of the program analysis unit report to the deputy head. This arrangement may well be the optimum solution in certain circumstances; it is not to be rejected out of hand. But, before it is adopted, consideration should be given to a number of factors.
- 3 For reasons of varying weight, it may be desirable to have the chiefs of many staff organizations reporting direct to the deputy head, such as the chief financial manager, the chief personnel officer, the chief of an organization and methods division and so on. But there is some practical limit to which a span of control can be extended. A deputy head may have also in direct line of reporting assistant deputy heads or directors general or both in charge of operational, administrative, or research branches; executive assistants; policy advisors; and headquarters staff specialists on the particular operations the department carries on. All these, and the enumeration is not exhaustive, will already vie for his attention. Since it is of ultimate importance that program budgeting have his attention, and a great deal of it, the new unit might be more successful if it is placed under the immediate charge of someone who already has a major responsibility for advising the deputy head on operational planning and achievement matters rather than if it is set up independently as an entirely new contender for notice. But the separation between the deputy head and the chief of program analysis should be no greater than one level of reporting.
- 4 A further consideration in the same general context is that while PPB theory as put forth in preceding chapters does, in general, provide a more systematic way of clarifying objectives and applying analysis to assist the achievement of objectives than appears to have existed before in government departments, planning did not start with PPB. If the department already has a well established planning division whose scope covers the whole range, or almost the whole range of the department's operations, the function of program analysis might well be located in that division, though the division would have to be given a new program budgeting orientation.
- 5 It is important to appreciate that such a planning division referred to above should be one concerned with the essential purposes of the department and not just its housekeeping. A department concerned with the provision of some service to the public may well have a division to plan how that service may be most effectively supplied that is to establish the need for the service, the conditions of eligibility, the best distribution of benefits given the funds available, etc. But it may also have another division to plan how the service may be most efficiently supplied – a division to develop

work standards for clerks, to design appropriate forms, to develop office layouts and work flows. The first is the kind of planning division where it could be appropriate to vest program analysis.

- 6 The new unit *could* be placed in the administration service of a department but before this is done, careful thought should be given by the deputy head to the kind of administration service he has. To draw upon a military analogy, most administration services, particularly those in large departments with several programs, are largely taken up with manning and logistics. These administration services react to and attempt to make possible the fulfillment of plans, but have usually only a small part to play in the formulation of plans. It would be a mistake to place program analysis in administration in such circumstances.
- 7 The companion volume to this, the Program Review and Estimates Manual, suggests the intimate connection between financial management and program budgeting. To reiterate a theme from Chapter I, program budgeting is being adopted to assist resource allocation, to promote the optimum deployment of the available financial resources of government. The formal presentation of the department's annual request for funds in the Program Review submission is usually the responsibility of the financial management division; the Program Review submission is the culmination to that date of the work in program analysis. In other words, the Program Review submission translates into dollar and man-year terms the resource requirements determined through analysis. There must then be co-ordination between whatever division is responsible for program analysis and the financial management division. The former must, for instance, look to the latter for information necessary in costing as well as for an indication of many of the financial constraints planning should realistically take into account.
- 8 The deputy head may decide that he wants the closest possible co-ordination between the two functions and decide to place the program analysis unit in the financial management division. But he should do so only if the latter is now in direct line of reporting to him and if it now plays a major part in planning. A director of financial management, even one at the required reporting level, whose orientation is heavily on the purely accounting aspects of financial management, may not be the appropriate bridge between the deputy head and the small group of economists, mathematicians, and engineers who will ideally make up the program analysis unit. There may be complex stores or revenue producing operations to absorb all his attention to the disadvantage of the analytic side and this is likely to inhibit the kind of rethinking of fundamental issues that PPB should promote.
- 9 These then are the factors the deputy head of each department and agency should bear in mind when deciding on the appropriate reporting relationship. Taking all these factors into account an arrangement which may commend itself to the deputy head is one under which the financial management, the information systems, the operational review, the organization and methods and the program analysis functions would all be assigned to a "Director of Program Analysis and Finance" who, in turn, would report to the deputy head.

Staffing

- 10 The program analysis unit should be started on a small scale and deliberately kept small. Of course, certain smaller departments and agencies are unlikely to warrant separate

units of this kind. The number of officers required will vary in the other departments according to the department's size and the number and variety of programs they carry on. To make the point clear but without suggesting limits that should be exactly observed, the number of officers required could be as few as one or two and as many as eight or ten.

- 11 The primary reason for emphasizing that the staff be kept small is the desirability that the unit remain a closely knit group having a shared understanding of problems under study. Much of the work they will do, in the early stages of a study in particular, will take the form of extended discussion as the widest range of alternatives are brought forward and examined for feasibility. The larger the staff, the less the understanding can be fully shared and the more formal and less free ranging the discussions will be forced to become.
- 12 From another stance, a limit in size should be accepted because of the difficulties that will be met in finding officers suited to the work. A good analyst is likely to be one who has undergone training in some disciplined approach to problem solving and who combines a fertile imagination with at least an appreciation for quantitative methods. The usual disciplines are economics, mathematics and engineering but it would not be unusual to find analysts with other backgrounds. In any case, unless he is a junior in training, the analyst should have had experience in the application of his specialty or specialties in a way to develop his analytic abilities. In addition, because of the necessity to communicate with management, each should have the ability to express himself orally and in writing on technical subjects without obscuring his meaning in the special vocabulary of his technical specialty.
- 13 The group should include a mixture of disciplines, not only because a complex problem may require attack with weapons drawn from different disciplines, but because the same problem can appear differently to a mathematician, an economist, and an engineer, and the different approaches they will be inclined to take are more likely to produce the best solution than a single approach.
- 14 It would be well too if some of the officers placed in the unit had long and varied departmental experience and if the others had not. The former would bring a knowledge of the department's subject matter and of practical restraints that must be observed in considering alternatives. The latter would tend to widen the probably more restricted vision of the former since the outsider will have to question as he learns about the department. He will also be more likely to raise for consideration radically new alternatives. Those with a knowledge of an existing program are often those whose view of difficulties and the potential for change has been severely conditioned by their experience.
- 15 From time to time, the capability of the analysis unit could with profit be supplemented by outside consulting service drawn from the Bureau of Management Consulting Services, universities, or commercial management consulting firms. Going back to the remark in Chapter 3 that the analyst is to be an extension of the manager, it is important that outside consultant service be used wisely and this means that the problems given to consultants are to be well defined. The definition of objectives, the assumptions and the judgement underlying analysis are in the end the manager's responsibility. The next component, knowledge of subject matter, is, in the nature of

things, more likely to be had by departmental personnel. The consultant can bring a knowledge of *techniques* but unless he is given an appropriate problem area for the application of techniques, the results are unlikely to be worth the money paid for his services. An extensive and early reliance on consultants without effort being made to set up a program analysis unit amounts to putting off a step that has to be taken eventually. The process of analysis will go on and it requires the continuity that a departmental unit can give, and a consultant cannot, over the long term.

APPENDIX A – THE FUNCTIONAL CLASSIFICATION

The classification has three levels – functions, sub-functions and functional program, indicated below by the successively greater indentations

GENERAL GOVERNMENT SERVICES

LEGISLATION AND ADMINISTRATION

- LEGISLATIVE
- EXECUTIVE AND POLICY
- COLLECTION OF TAXES AND DUTIES
- INTERNAL MANAGEMENT SERVICES
- CONTRIBUTIONS TO EMPLOYEE PENSION AND MEDICAL PLANS
- CONTINGENCY VOTE
- NATIONAL CAPITAL REGION
- BULLION AND COINAGE
- OTHER LEGISLATION AND ADMINISTRATION

PROTECTION OF PERSONS AND PROPERTY

- JUSTICE
- CORRECTIONAL SERVICES
- POLICE PROTECTION
- CONSUMER SERVICES
- OTHER PROTECTION OF PERSONS AND PROPERTY

FOREIGN AFFAIRS

EXTERNAL RELATIONS

- DIPLOMATIC RELATIONS
- CONTRIBUTIONS TO INTERNATIONAL ORGANIZATIONS

ASSISTANCE TO DEVELOPING COUNTRIES

- OTHER FOREIGN AFFAIRS

DEFENCE

INTERGOVERNMENTAL FISCAL TRANSFER PAYMENTS

- STATUTORY SUBSIDIES TO PROVINCIAL GOVERNMENTS
- REVENUE EQUALIZATION PAYMENTS
- OTHER FISCAL TRANSFER PAYMENTS

ECONOMIC MEASURES**PRIMARY INDUSTRY**

AGRICULTURE
FISHERIES
FORESTRY
MINERALS
WATER RESOURCES
ENERGY
OTHER PRIMARY INDUSTRY

SECONDARY INDUSTRY**TRANSPORTATION AND COMMUNICATIONS**

AIR TRANSPORT
WATER TRANSPORT
RAIL TRANSPORT
ROAD TRANSPORT
POSTAL SERVICES
TELECOMMUNICATIONS
OTHER TRANSPORTATION AND COMMUNICATIONS

SERVICE INDUSTRY

TOURISM
OTHER SERVICE INDUSTRY

FOREIGN TRADE**LABOUR FORCE**

WORKING CONDITIONS
TRAINING
IMMIGRATION
OTHER LABOUR FORCE

GENERAL RESEARCH

SOCIAL SCIENCE RESEARCH
PHYSICAL SCIENCE RESEARCH
OTHER GENERAL RESEARCH

HOUSING AND URBAN RENEWAL

Regional Development

OTHER ECONOMIC MEASURES

SOCIAL MEASURES

HEALTH

PUBLIC HEALTH
MEDICAL CARE
HOSPITAL CARE
OTHER HEALTH

INCOME MAINTENANCE

PAYMENTS TO AGED
PAYMENTS TO FAMILIES
PAYMENTS TO UNEMPLOYED

SOCIAL ASSISTANCE

CANADA ASSISTANCE PLAN
AID TO HANDICAPPED
OTHER SOCIAL ASSISTANCE

VETERANS BENEFITS

INDIANS & ESKIMOS

OTHER SOCIAL MEASURES

EDUCATION, CULTURE & RECREATION

AID TO EDUCATION

POST SECONDARY EDUCATION TRANSFER
OTHER AID TO EDUCATION

CULTURE AND RECREATION

ARCHIVES, GALLERIES, MUSEUMS, LIBRARIES AND THEATRES
PARKS, HISTORIC SITES AND OTHER RECREATIONAL AREAS
FILM, RADIO AND TELEVISION
OTHER CULTURE AND RECREATION

PUBLIC DEBT

FINANCIAL TRANSACTIONS

FUNCTION			General Government Legislative and Administrative		Economic Measures					Labour Force
SUB-FUNCTION			Internal Management		Transportation and Communications					Immigration
FUNCTIONAL PROGRAM										
DEPARTMENT	SELECTED PROGRAMS	SELECTED ACTIVITIES			Air Transport	Water Transport	Rail Transport	Telecommu- nications		
Manpower and Immigration	Manpower Immigration	All								
Transport	Air Services	Radio Airt and Regulations								
		Meteorological Services								
		All other								
	Railways and Steamships	Subsidies to Railways								
		Subsidies to Ferries								
National Health and Welfare	Medical Services	Civil Aviation Medicine								
		Indian Health								
		Civil Service Health								
		Immigration Medicine								
		Sick Mariners Service								

APPENDIX A

Chart illustrating relationships of functions, sub-functions, functional programs and departmental programs.

APPENDIX B

EXPENDITURES ON PROGRAMS AND ACTIVITIES OF DEPARTMENTS AND AGENCIES, 1967-68 CLASSIFIED BY FUNCTION

GENERAL GOVERNMENT SERVICES

(millions of dollars)

LEGISLATION AND ADMINISTRATION

Legislative

House of Commons	14.3
Senate	3.4
Library of Parliament	.6
Chief Electoral Officer	.3
Representation Commissioner	.1
Auditor General	2.3
	<u>21.0</u>

Executive and Policy

Governor General and Lieutenant Governors	1.0
Privy Council Office Administration	3.7
Finance Administration	3.9
Treasury Board Administration	4.6
Royal Commissions	2.7
	<u>15.9</u>

Collection of Taxes and Duties

Taxation (NRT)	57.8
Customs and Excise (NRCE)	59.0
Tariff Board	.5
Tax Appeal Board	.3
	<u>117.6</u>

Internal Management Services

Language Training	5.0
Public Service Commission (excl. Language Training)	7.9
Public Service Staff Relations Board	1.0
Public Service Health (NHW)	.8
Accommodation Services (DPW)	133.9
Supply (DDP)	7.6
Purchasing (DDP)	9.4
Project Management (DDP)	3.0
Public Printing and Stationery	4.8
Comptroller of the Treasury	32.1
Legal Services (JUS)	2.2
Translation Bureau (SS)	4.1
Records Management & Technical Services (NL)	.7

Internal Management Services (Concl'd.)

Actuarial Services (INS)	.2
Grants in lieu of Taxes on Federal Property (FIN)	41.0
DPW Administration	<u>23.9</u>
	<u>277.6</u>

Government Contributions to Employee Pension and Medical Plans

Contribution to Public Service Superannuation Account	122.6
Contribution to Canada & Quebec Pension Plans	17.6
Group Surgical Medical Insurance Plan and Other Pension Plans	14.3
Government Employees' Compensation (LAB)	2.9
	<u>157.4</u>

CONTINGENCY VOTE

33.6

National Capital Region

National Capital Commission	<u>23.9</u>
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Bullion and coinage

Royal Canadian Mint (FIN)	<u>4.0</u>
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Other Legislation and Administration

Territorial Governments	11.0
State Visits	2.3
Statute Revision Commission	—
	<u>13.3</u>

Sub Function Total 664.3

PROTECTION OF PERSONS AND PROPERTY

Justice

Justice Departmental Administration and Constitutional Matters	.7
Supreme and Exchequer Court Administration	.7
Judges Salaries and Pensions	11.8
	<u>13.2</u>

Correctional Services

Solicitor General Administration	.9
Correctional Services	57.3
	<u>58.2</u>

Police Protection

Royal Canadian Mounted Police	<u>92.7</u>
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Consumer Services

Food and Drug (NHW)	8.2
Standards Branch (TC)	4.3
Consumer and Corporate Affairs Administration	.7
Consumers (CCA)	.2
	<u>13.4</u>

Other Protection of Persons and Property

Bankruptcy Act (CCA)	.8
Combines Investigation (CCA)	1.2
Canada Corporations Act (CCA)	.2
Supervision of Companies (INS)	1.1
Race Track Supervision (AGR)	1.6
	<u>4.9</u>

Sub Function Total 182.4

FUNCTION TOTAL 846.7

FOREIGN AFFAIRS

\$ millions

EXTERNAL RELATIONS**Diplomatic Relations**

External Relations 48.5

Contributions to International Organizations

All Contributions (EA) 15.6

Sub Function Total 64.1

ASSISTANCE TO DEVELOPING COUNTRIES

External Aid Office Administration	2.9
Caribbean Sugar Payments (FIN)	1.1
International Aid (EXT)	15.3
External Aid Office Grants	130.3

Sub Function Total 149.6

FUNCTION TOTAL 213.7

DEFENCE

\$ millions

National Defence Department	1,699.2
Defence Research Board	47.0
Defence Construction Limited	2.3
Canadian Arsenals Limited	.4
Defence Industry Support (DDP)	.4
Defence Industry Technology (DOI)	32.4

DEFENCE (Concl'd.)

Emergency Measures Organization	8.8
Emergency Health Services (NHW)	1.9
Emergency Supply Planning (DDP)	.9

FUNCTION TOTAL	<u>1,793.3</u>
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INTERGOVERNMENTAL FISCAL TRANSFER PAYMENTS

STATUTORY SUBSIDIES TO PROVINCIAL GOVERNMENTS	<u>31.7</u>
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REVENUE EQUALIZATION PAYMENTS	<u>598.4</u>
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OTHER FISCAL TRANSFER PAYMENTS

Payments to Quebec under Established Programs Act and Fiscal Revision Act	134.1
Share of Public Utilities Income Tax	6.7

FUNCTION TOTAL	<u>770.9</u>
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ECONOMIC MEASURES**PRIMARY INDUSTRY****Agriculture**

Agriculture Administration	6.5
Health of Animals (AGR)	18.5
Production and Marketing (AGR)	
(Excludes Crop Insurance and Racetrack Supervision)	41.9
Research (AGR)	39.4
Land Irrigation and Water Projects (AGR)	22.8
Board of Grain Commissioners	9.9
Wheat Price Maintenance (TC)	2.7
Canadian Dairy Commission (4)	124.9
Carrying Costs, Temporary Wheat Reserves (TC)	29.3
Canadian Livestock Feed Board	21.6
Farm Credit Corporation	3.8
Farm Improvement Loans Act (FIN)	.3
Agriculture Manpower (MI)	.1
Crop Insurance	2.6
	<u>324.3</u>

Fisheries

Fisheries Administration	3.4
Fisheries Management and Development	33.6
Fisheries Research Board	14.8
	<u>51.8</u>

Forestry

Forestry Program	<u>20.6</u>
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Minerals

Roads to Resources	2.8
Energy Mines and Resources Departmental Administration	4.2
Geological Research (EMR)	9.7
Mining and Metallurgical (EMR)	7.7
Gold Mining Assistance Payments (EMR)	15.4
Eastern Coal Subventions (EMR)	3.0
Mineral Development (Excl. Roads, Eastern Coal and Gold Mining Assistance) (EMR)	<u>1.1</u>
	<u>43.9</u>

Water Resources

Water Resources (EMR)	49.2
International Joint Commission (EXT)	<u>.4</u>
	<u>49.6</u>

Energy

Atomic Energy of Canada Limited (4)	66.5
Atomic Energy Control Board	2.8
Atlantic Development Fund (ADB)	18.6
National Energy Board	1.5
Dominion Coal Board	<u>35.2</u>
	<u>124.6</u>
Sub Function Total	<u>614.6</u>

SECONDARY INDUSTRY

Department of Industry Administration	10.3
Advancement of Industrial Technology (DOI)	6.4
Small Business Loans Act (FIN)	.2
Industrial Research Assistance (NRC)	5.1
Patents, Copyrights, Trademarks (CCA)	4.3
Haley Industry Losses and Sale	1.2
Commercial and Fishing Vessels Subsidy (DOI)	39.3
General Incentives for Research and Development (DOI)	2.1
General Incentives for Design (DOI)	
Sub Function Total	<u>68.9</u>

TRANSPORTATION AND COMMUNICATIONS**Air Transport**

Air Services (DOT)	111.7
Payments to Air Carriers (CTC)	3.0
Civil Aviation Medicine (NHW)	<u>.1</u>
	<u>114.8</u>

Water Transport

Marine Service (DOT)	93.5
Subsidies to Ferries (DOT)	46.4
National Harbours Board (Excl. J. Cartier Bridge)	6.1
Harbours and Rivers (DPW)	44.0
Saint Lawrence Seaway	10.4
Sick Mariners Service (NHW)	1.5
Steamship Subventions (CTC)	11.0
	<u>212.9</u>

Rail Transport

Subsidies to Railways (DOT)	62.1
Railway Subsidies (CTC)	110.0
	<u>172.1</u>

Road Transport

Trans-Canada Highway (DPW)	66.7
Northumberland Causeway (DPW)	5.0
Northwest Highway (DPW)	7.5
Other Roads and Bridges (DPW)	4.6
Trunk Highways (ADB)	19.3
Jacques Cartier Bridge Deficit (NHB)	.5
Railway Grade Crossing Fund (CTC)	15.0
	<u>118.6</u>

Postal Services

Post Office	<u>301.9</u>
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Telecommunications

Research Satellite Program (DND)	3.5
Radio Act and Regulations (DOT)	2.0
	<u>5.5</u>

Other Transportation and Communications

Department of Transport Administration	6.9
Meteorological Services (DOT)	25.5
Canadian Transportation Commission Administration	3.6
	<u>36.0</u>

Sub Function Total 961.8

SERVICE INDUSTRY**Tourism**

Travel Development (TC)	10.0
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Sub Function Total 10.0

FOREIGN TRADE

Trade and Commerce Administration	1.7
Trade Development (TC)	22.6
World Fairs (TC)	7.5
Foreign Military Marketing (DDP) (including CCC)	4.7
Pacific National Exhibition	1.4

Sub Function Total	<u>37.9</u>
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LABOUR FORCE

Working Conditions

Department of Labour Administration	1.8
Labour Standards (LAB)	1.4
Research and Development (LAB)	1.6
Labour Relations (LAB)	1.3
	<u>6.1</u>

Training

Occupational Training for Adults (MI)	104.5
Capital Assistance, Technical and Vocational Schools (MI)	119.0
Technical and Vocational Training (MI)	85.6
	<u>309.1</u>

Immigration

Immigration (MI)	21.7
Immigration Medical Services (NHW)	2.7
Citizenship Registration (SS)	1.3
Immigration Appeal Board	.3
Immigrant Integration (Citizenship Branch – SS)	.7
	<u>26.7</u>

Other Labour Force

M & I Departmental Administration	4.2
Employment Services (MI)	36.3
Manpower Mobility	3.3
Employment Stabilization	27.0
Manpower Administration	4.6
Program Development (MI)	7.0
	<u>82.4</u>

Sub Function Total	<u>424.3</u>
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GENERAL RESEARCH

Social Science Research

Dominion Bureau of Statistics	22.5
Economic Council	1.6
	<u>24.1</u>

Physical Science Research

NRC University Grants	45.5
National Research Council	50.5
Scientific Council (PC)	.4
Astronomy and Physics (EMR)	6.0
Polar Continental Shelf (EMR)	1.8
	<u>104.2</u>
Sub Function Total	<u>128.3</u>

HOUSING AND URBAN RENEWAL

Contributions to Urban Renewal Schemes (CMHC)	8.0
Sewage Treatment Projects (CMHC)	7.9
Losses, Operation of Public Housing Projects (CMHC)	2.4
Housing Research & Community Planning (CMHC)	3.1
Municipal Development Loan Board	1.2
Sub Function Total	<u>22.6</u>

REGIONAL DEVELOPMENT

Rural Development (ARDA etc. excl. FRED) (FRD)	31.4
FRED (FRD)	5.7
Cape Breton Development Corporation (EMR)	—
Northern Administration (excl. Territorial Gov't) (IAND)	55.6
ADB Administration	2.2
Dosco Special Vote (ADB)	2.0
Grants Scholarships and Bursaries for Industrial and Area Development (DOI)	.2
Area Development Incentive Grants (DOI)	15.4
Sub Function Total	<u>112.5</u>

OTHER ECONOMIC MEASURES

Forestry Departmental Administration (FRD)	1.7
Field and Air Surveys (EMR)	10.9
IAND Departmental Administration	2.4
Sub Function Total	<u>15.0</u>

FUNCTION TOTAL	<u><u>2,396.1</u></u>
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\$ millions

SOCIAL MEASURES**HEALTH****Public Health**

General Health Grants (NHW)	29.6
Grants to Health Organizations (NHW)	.2
Quarantine Services (NHW)	.7
Public Health Sanitarian Services (NHW)	.2
	<u>30.7</u>

Medical Care

Health Resources Fund (NHW)	32.6
Medical Research Council (NRC)	20.7
	<u>53.3</u>

Hospital Care

Hospital Insurance Grants (NHW)	468.6
Hospital Construction Grants (NHW)	16.4
	<u>485.0</u>

Other Health

Northern Health Services (NHW)	9.0
NHW Department Administration	3.6
Health and Medical Activities Administration (NHW)	10.2
	<u>22.8</u>

Sub Function Total 591.8**INCOME MAINTENANCE****Payments to Families**

Family Allowances (NHW)	558.9
Youth Allowances (NHW)	49.5
Family Assistance Payments (NHW)	4.2
	<u>612.6</u>

Payments to Unemployed

Unemployment Insurance Administration	37.6
Government's Contribution to UIC Fund	68.8
Auto Workers, Transitional Assistance (LAB)	.7
	<u>107.1</u>

Sub Function Total 719.7**SOCIAL ASSISTANCE****Canada Assistance Plan**232.1

Aid to Handicapped

Rehabilitation Services (NHW)	.6
Disabled Persons Allowances (NHW)	7.1
Blind Persons Allowances (NHW)	2.3
Vocational Rehabilitation, Disabled Persons (MI)	2.4
	<u>12.4</u>

Other Social Assistance

Welfare Activities Administration (NHW)	8.4
Old Age Assistance (NHW)	8.9
Company of Young Canadians (SS)	2.4
Vanier Institute (FIN)	.8
Mental Retardation Grants (NHW)	.3
Special Assistance Bell Island (ADB)	.3
Governments Annuities Act (LAB)	1.1
National Welfare Grants	1.9
	<u>24.1</u>

Sub Function Total 268.6

VETERANS BENEFITS

Veterans Affairs Administration	5.5
Pensions (DVA)	209.1
Treatment Services (DVA)	60.7
Veterans' Land Act	9.2
Welfare Services (DVA)	114.3

Sub Function Total 398.8

INDIANS & ESKIMOS

Indian Programs (IAND)	122.7
Indian Health Service (NHW)	25.2
Indian Integration (Citizenship Branch - SS)	.2

Sub Function Total 148.1

FUNCTION TOTAL 2,127.0

EDUCATION, CULTURE AND RECREATION**AID TO EDUCATION****Post Secondary Education Transfer Payments**

Education Grants (SS)	<u>108.2</u>
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Other Aid to Education

Student Loans (FIN)	5.7
	<u>5.7</u>

Sub Function Total 113.9

CULTURE AND RECREATION**Archives, Galleries, Theatres, Etc.**

Canada Council	16.9
Other National Museums	3.8
National Gallery	2.9
Public Archives	1.3
National Library	1.6
National Arts Centre	20.6
City of Ottawa for Civic Centre	.4
	<u>47.5</u>

PARK, HISTORIC SITES, AND OTHER RECREATIONAL AREAS

National Parks and Historic Sites (IAND)	33.9
Canadian Wild Life Service (IAND)	3.7
	<u>37.6</u>

FILM, RADIO AND TELEVISION

Canadian Broadcasting Corporation	144.0
National Film Board	9.3
Canadian Radio – Television Commission	1.3
Canadian Film Development Corporation (SS)	—
	<u>154.6</u>

OTHER CULTURE AND RECREATION

Secretary of State Department Administration	1.9
Fitness and Amateur Sport (NHW)	4.1
Grant to Ottawa YMCA (FIN)	—
Citizenship Branch (SS) (Excludes Indian and Immigrant Integration)	1.1
Centennial Commission	31.2
Cité du Havre expenditures	—
	<u>38.3</u>

Sub Function Total 278.0

FUNCTION TOTAL 391.9

PUBLIC DEBT

\$ millions

Interest and Annual Amortization of Bond Discount Premiums & Commissions	1,294.1
Servicing Costs & Costs of Issuing New Loans	4.5

FUNCTION TOTAL 1,298.6

APPENDIX C

DISTRIBUTION OF COSTS OF ADMINISTRATIVE PROGRAMS AND ACTIVITIES

- 1 Many departments, particularly the large ones, will want to have an administration program containing the central headquarters activities involved in operating the department as an entity. In some applications of PPB theory, the costs of an administration program would be distributed to each activity in the other programs according to the "service" the administration program supplies to the activity. This approach could easily occasion the creation of very elaborate costing systems since costs originally incurred by the Personnel Division, for instance, would have to be charged to every other activity in the department for each employee recruited. This would include the costs of issuing a poster, holding competition boards, paying removal allowances and processing certificates of appointment. Similarly the costs of preparing financial statements by a Financial Management Division in the Administration program and the costs of work measurement studies by an Organization and Methods Division would have to be financed through the funds supplied to "line" programs.
- 2 As mentioned in Chapter 1 of this guide, the Canadian PPB System has not been developed along these lines. The concepts which are being adopted are
 - (a) that administrative programs and activities should contain only those activities which naturally belong there; and
 - (b) administration costs should be justified in terms of the burden placed on administration by the non-administrative programs and activities.
- 3 Typically, the administration program costs should include the funds necessary for the Minister's and Deputy Minister's offices and for the divisions or sections for personnel, program analysis, financial management, organization and methods, forms control, forms management, and office services. In most cases operations such as the departmental library will also fall within the Administration program as will small, general purpose, data processing units. Normally all the activities which the department has decided to place in the central administration responsibility structure (for organizational purposes) will not automatically belong in the Administration program. If an activity wholly or primarily serves one of the other programs of the department, for costing purposes it should be shown as forming part of that other program.
- 4 With respect to the support of changes in administrative costs because of the burden placed on administration by other programs and activities, the following example may serve to illustrate the general approach.
- 5 Suppose, a department has four programs:
 - (a) Administration
 - (b) Research
 - (c) Operations A
 - (d) Operations B

The department would then estimate, in percentage terms, the relative burden placed by the last three programs on the administration program — e.g.:

	Burden on Administration Program
Research	30 %
Operations A	24 %
Operations B	46 %
	100 %

These percentages would have been obtained by estimating the burden on each activity in the administration program as illustrated in the following table.

	Activities in Administration Program					Total Cost of Administration Program
	Senior Management	Personnel Division	Financial Management Division	Organization & Methods Division	Office Services	
Current annual cost (\$000)	45	170	150	100	85	550

	Percent Burden per Administration Activity					Weighted Total (\$000)
Research	20	45	25	0	50	165.5
Operations A	40	15	35	10	30	131.5
Operations B	40	40	40	90	20	253.0
	100	100	100	100	100	550.0

- 6 The percentages shown in the above table do not need exact study for their estimation. In personnel, for instance, the rate of staff turnover in each of the three programs is probably an adequate estimate, with some adjustment for the more difficult staffing problems occasioned in some programs. Good informal guesses with some attention to each administration activity's records should serve in deriving adequate estimates. The method of deriving the weighted total for a program is illustrated for the case of the Research Program.

$$(20 \times 45) + (45 \times 170) + (25 \times 150) + (50 \times 85) = \$165.5 \text{ (000)}$$

- 7 The financial allocation to an administration program will therefore generally be based on the allocation made to the programs administered in terms of the burden these other programs place on administration. This principle may be best conveyed by an illustration. Let us assume the hypothetical program structure mentioned above and also assume the costs of these programs and the additional allocations as shown:

	Current Year Cost	Burden on Admin.	Additional Allocation		Tentative Additional Allocation to Admin.
	(1)	(2)	(3)	(4)	(5)
	\$000's	\$000's	\$000's		(2) x (4)
Administration	500				
Research	20,000	165.5	5,000	25%	41.4
Operations A	10,000	131.5	1,000	10%	13.2
Operations B	30,000	253.0	6,000	20%	50.6
					<u>105.2</u>

Thus the apparent additional required financial allocation for Administration would be \$105,200.

- 8 The final allocation could of course be different for the following kinds of reasons:
 - (a) The additional allocation to a non-administration program may take the form of additional money for grants and construction which need not increase the burden on Administration. If no increase in the administrative burden is expected, an increased allocation to the non-administration program would not justify an increase in the administration program.
 - (b) There may be a valid reason for increasing the amount allowed for the administration program regardless of what happens in the other programs because of the introduction of new work e.g. the initiation of staff training in a department which had no training capability in the past, exceptionally high recruiting costs in a high demand field of specialization, etc.

APPENDIX D

AN ILLUSTRATION OF COST-BENEFIT ANALYSIS*

1 As a simplified example of a cost benefit analysis, this section will analyse two approaches to a hydro power generation program. It must be assumed that the basic decision in favour of hydro power has already been made and that there are only two technically feasible solutions to the problem.

2 For the purpose of this expository example it will also be assumed that two different river systems are involved and each alternative is only feasible on one system.

System A: The construction of a series of small dams which can be built to generate power at 10, 20, 30, 40, 50 or 60 megawatts.

System B: The construction of a single large dam which, depending on height and location, can be built to generate power at 75, 90, 100, 125, 150 or 200 megawatts.

A further complication is introduced in system A since there is only one site from which power can be generated in the 30 to 60 megawatt range although there are a number of possible sites for smaller dams.

3 Before making a choice between A and B it is necessary to determine the best possible scale for each. The following table (CI) summarizes the data provided to deal with system A:

4 Two columns in particular should be noted, the fourth showing net benefits and the last showing the ratio of incremental benefits to incremental costs. This ratio $\Delta B/\Delta C$ shows what may be expected in additional benefits for additional expenditures and as long as it is greater than 1.0, the additional benefits accruing will exceed the additional costs incurred to obtain these benefits. It is apparent that the optimum scale for alternative A is reached at 40MW since each increase in expenditures beyond this point would exceed the benefits obtained. The optimum scale under alternative A would therefore appear to be the 40MW project. A similar argument, not reproduced here, indicates that the optimum scale for project B is a 100MW project at a cost of \$27.9 million and with benefits of \$44.5 million.

5 The costs included in this first stage of the analysis would be the capital investment and future operating costs of the dams and the benefits would be measured at the price at which the power generated would be sold.

* This illustration is suggested by one appearing in the publication "Guide to Benefit-Cost Analysis" by W.R.D. Swell, J. Davis, A.D. Scott and D.W. Ross, available from the Queen's Printer and Comptroller of Stationery, price \$1.25. Different numerical values are used here to permit abbreviation of the illustration.

Scale	Costs	Benefits	Net Benefit	Benefit Cost Ratio	Incremental Costs ΔC	Incremental Benefits ΔB	Ratio $\Delta B / \Delta C$
MW	\$000,000				\$000,000		
10	4.0	5.5	1.5	1.38			
20	7.6	10.7	3.1	1.41	3.6	5.2	1.44
30	10.9	15.6	4.7	1.43	3.3	4.9	1.48
40	14.1	20.2	6.1	1.43	3.2	4.6	1.44
50	19.0	24.5	5.5	1.29	4.9	4.3	.88
60	23.7	28.5	4.8	1.20	4.7	4.0	.85

TABLE C I

Cost data for system A

(Note:-- It is assumed that beyond a capacity of 60MW the unit cost/Kwh remains constant.)

- 6 We must next assess the expected demand. It is assumed that the demand would start in year one at 10MW and grow regularly to 100MW by year ten and remain constant at this level thereafter. This demand would appear to be best met by:

Alternative A: One 40MW project and three 20MW projects,

Alternative B: One 100MW project.

- 7 Alternative A appears the more attractive at first sight since the small projects can be built roughly as needed in step with the growth in demand while B must be built in one operation at the beginning of the project. To resolve this question, the present value of the following series of expenditures and benefits must be calculated.

- (a) The present value of the four capital investments in A, incurred as they become necessary with the growth in demand.
- (b) The present value of the benefits.
- (c) The present value of the operating and maintenance costs of A.
- (d) The present value of the operating and maintenance costs of B.

- 8 It immediately becomes apparent that we must ask a lot more questions before starting the detailed analysis:

- (a) What is the interest rate to be used? For the purpose of this example let us assume 5%.
- (b) How long does it take to build a dam? Let us assume that one year after the money has been encumbered we can start selling power.
- (c) How much will operation and maintenance cost? Let us assume \$.1 million per dam per year.
- (d) Is it permissible to allow the demand to wait on supply or must it be met as it arises? Let us assume that the demand must be met within one year of its arising.
- (e) What is the working (financial) life of the project? Let us assume 20 years in calculating the income per year.

In practice few of these questions have simple answers but for the purposes of this example it is necessary to make some sweeping assumptions.

- 9 Looking at project A we must decide on what order to use in our construction program. To avoid violating the demand assumption in (d) above, it is necessary to build something immediately. It is also necessary to decide on whether to build to anticipate requirements, or to meet existing requirements. For instance if we start by building the 40MW dam this will be satisfactory until the end of year four. Do we then build a 20MW dam during year four to meet the anticipated demand in year five or build during year five to meet our commitment under criterion (d) and the demands of year six.
- 10 Consider building during year four as case X, during year five as case Y. Table CII demonstrates the simple analysis necessary to determine that building during year five is a better financial proposition and still satisfies the requirement that the demand must be met within one year of its arising.

Alternative X

Year	Expenditure \$000,000	Income \$000,000	Net Income \$000,000	Present Value in year 4 \$000,000
4	7.60	-	- 7.60	- 7.60
5	.10	.09	- .01	- .01
6	.10	.17	+ .07	+ .06
7	.10	.17	+ .07	+ .06

Net Present Value
at year 4
-\$7.49 million.

Alternative Y

Year	Expenditure \$000,000	Income \$000,000	Net Income \$000,000	Present Value in year 4 \$000,000
4	-	-	-	-
5	7.60	-	- 7.60	- 6.89
6	.10	.17	+ .07	+ .06
7	.10	.17	+ .07	+ .06

Net Present Value
at year 4
-\$6.77 million.

TABLE C II

Comparison between building in year four or year five to satisfy demand in years five and six.

(NOTE: Both alternatives are identical beyond year six)

Year	Demand MW	Const. Schedule MW	Const. Cost \$000,000	Maint. Cost \$000,000	Income \$000,000	Net Income \$000,000	Present Value \$000,000	Total Present Value \$000,000
1	10	40	14.1			- 14.100	- 13.429	
2	20			.100	.535	+ .435	+ .395	
3	30			.100	.780	+ .680	+ .587	
4	40			.100	1.010	+ .910	+ .749	
5	50	20	7.6	.100	1.010	- 6.690	- 5.242	
6	60			.200	1.425	+ 1.225	+ .914	
7	70	20	77.6	.200	1.425	- 6.375	- 4.531	
8	80			.300	1.825	+ 1.525	+ 1.032	
9	90	20	7.6	.300	1.825	- 6.075	- 3.916	
10	100			.400	2.225	+ 1.825	+ 1.120	- 22.321
11-20	100			.40p.a.	2.285p.a.	+ 1.825p.a.	+ 8.651	- 13.670
21-30	100			.40p.a.	2.225p.a.	+ 1.825p.a.	+ 5.311	- 8.359
31-40	100			.40p.a.	2.225p.a.	+ 1.825p.a.	+ 3.261	- 5.098
41-50	100			.40p.a.	2.225p.a.	+ 1.825p.a.	+ 2.002	- 3.096

TABLE C III
Net Present Value of System A

- 11 It is now possible to establish a construction schedule for alternative A and look at the overall cost. Table CIII shows the development of net present value calculated from the construction cost, an estimate of maintenance costs, predicted income from the sale of power and the reduction of all these future values to the present which is taken to be at the beginning of year one. It will be seen that the net present value even after 50 years is still negative, and in fact it will take about 70 years to break even if the sale of power is the only benefit considered.
- 12 Table CIV shows a similar calculation for alternative B which gives a break even point after 40 years with an ever increasing net benefit beyond this point. At the same time the benefit cost ratio, which can be calculated for any time period as

Present Value of benefits

Present Value of capital costs + Present Value of operation and maintenance costs

is consistently larger than for alternative A

- 13 It must be realized that for most government projects it is most unlikely that a calculation of this type would be the only factor taken into consideration before a decision is made. There may well be limitations with regard to the amount of farmland which may be taken out of production, the resettlement of displaced farmers, recreational values, transportation and access problems etc. As far as possible these factors should be quantified and reduced to monetary values in an effort to establish a common measure for the analysis.
- 14 In conclusion it must be pointed out that this is a simplified approach to a problem which had itself been simplified. In practice the assumptions made would have to be carefully examined and would probably be the subjects of studies in their own right. The calculations would have to be repeated for different interest rates, different power demands and possible changes in the overall criteria; for example, supply could be allowed to lag behind demand for two years rather than for one. The entire problem must in fact be subjected to sensitivity analyses for all these variables to determine whether or not the overall decision or ranking of preferences would be affected by changes in the assumptions.

Year	Demand MW	Const. Schedule MW	Const. Cost \$000,000	Maint. Cost \$000,000	Income \$000,000	Net Income \$000,000	Present Value \$000,000	Total Present Value \$000,000
1	10	100	27.9			- 27.9	- 26.571	
2	20			. 20	.535	+ .335	+ .304	
3	30			. 20	.780	+ .580	+ .501	
4	40			. 20	1.010	+ .810	+ .666	
5	50			. 20	1.225	+ 1.025	+ .803	
6	60			. 20	1.425	+ 1.225	+ .914	
7	70			. 20	1.625	+ 1.425	+ 1.013	
8	80			. 20	1.825	+ 1.625	+ 1.047	
9	90			. 20	2.025	+ 1.825	+ 1.120	
10	100			. 20	2.225	+ 2.025	+ 1.243	- 18.960
10-20	100			. 20 p.a.	2.225p.a.	+ 2.025p.a.	+ 9.599	- 9.361
21-30	100			. 20 p.a.	2.225p.a.	+ 2.025p.a.	+ 5.893	- 3.468
31-40	100			. 20 p.a.	2.225p.a.	+ 2.025p.a.	+ 3.618	+ .150
41-50	100			. 20 p.a.	2.225p.a.	+ 2.025p.a.	+ 2.221	+ 2.371

TABLE C IV
Net Present Value of System B

APPENDIX E

SELECTED BIBLIOGRAPHY

There is a large volume of literature available on Program Planning and Budgeting but the following brief list covers some of the more general comprehensive works. For detailed studies, some of the volumes listed provide more extensive bibliographies.

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- *Planning-Programming-Budgeting, Official Documents*
 - *Planning-Programming-Budgeting, Selected Comments*
 - *Planning-Programming-Budgeting, Initial Memorandum.*

APPENDIX D

TABLES

RESEARCH AND DEVELOPMENT EXPENDITURES 1960-68

TABLE I — FEDERAL EXPENDITURES FOR R&D

**TABLE II — GROSS NATIONAL EXPENDITURES
FOR R&D (GERD)**

TABLE III — FEDERAL CONTRIBUTIONS TO GERD

RESEARCH AND DEVELOPMENT EXPENDITURES
1960-68
(\$000,000's)

TABLE I - Federal Expenditures for R&D*

	Intramural		Industry		University		Other (1)	Total
	\$	% of Total	\$	% of Total	\$	% of Total	\$	\$
1960-61	169	84	18	9	12	6	3	202
1961-62	195	84	21	9	14	6	3	233
1962-63	183	82	20	9	17	8	3	223
1963-64	180	75	36	15	22	9	2	240
1964-65	201	73	45	16	30	11	1	277
1965-66	226	67	66	20	42	13	2	336
1966-67	251	68	59	16	53	14	5	368
1967-68	298	66	67	15	71	16	16	452
1968-69 (est)	320	62	90	17	95	18	15	520

TABLE II - Gross National Expenditures for R&D (GERD)*

	Federal Intramural		Industry Total		University Total		Other (1)	Total
	\$	% of GERD	\$	% of GERD	\$	% of GERD	\$	\$
1960-61	169	53	93	29	52	16	8	322
1961-62	195	50	131	33	58	15	10	394
1962-63	183	45	140	35	70	17	11	404
1963-64	180	39	184	40	85	18	13	462
1964-65	201	36	238	42	108	19	14	561
1965-66	226	33	288	43	146	22	17	677
1966-67	251	33	303	40	189	25	22	765
1967-68	298	33	340(est)	38	240(est)	27	20(est)	898(est)

TABLE III - Federal Contributions to GERD

	Federal Total		GERD
	\$	% of GERD	\$
1960-61	202	63	322
1961-62	233	59	394
1962-63	223	55	404
1963-64	240	52	462
1964-65	277	49	561
1965-66	336	50	677
1966-67	368	48	765
1967-68	452	50	898 (est)

* Current & capital expenditures

(1) Private non-profit organizations, provincial research councils and non-teaching hospitals.



First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 27

THURSDAY, FEBRUARY 6th, 1969

WITNESSES:

Department of Labour: Harry J. Waisglass, Chairman, Inter-departmental Committee of Socio-Economic Research; Dr. A. W. J. Craig, Chairman, Policy Research Group, Economics and Research Branch; and Dr. George Saunders, Director, Economics and Research Branch.

APPENDIX:

28.—Brief submitted by the Department of Labour.

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird
Belisle
Blois
Bourget
Cameron
Carter
Desruisseaux
Giguère

Grosart
Haig
Hays
Kinneir
Lamontagne
Lang
Leonard
McGrand

Nichol
O'Leary (*Carleton*)
Phillips (*Prince*)
Robichaud
Sullivan
Thompson
Yuzyk

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,
The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th 1969:

With leave of the Senate,
The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

Thursday, February 6th, 1969

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 3.30 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Blois, Cameron, Haig, Kinnear, Robichaud and Thompson — 7.

In attendance:

Philip J. Pocock, Director of Research
(*Physical Science*).

The following witnesses were heard:

DEPARTMENT OF LABOUR

Harry J. Waisglass, Chairman, Inter-departmental Committee of Socio-Economic Research;
Dr. A. W. J. Craig, Chairman, Policy Research Group, Economics and Research Branch; and
Dr. George Saunders, Director, Economics and Research Branch.

In attendance:

Miss E. Lorentsen, Director, Legislation Branch; and
Mr. John Mainwaring, Director, International Labour Affairs Branch.

(A curriculum vitae of each witness follows these Minutes).

The following is printed as Appendix No. 28.

Brief submitted by the Department of Labour.

At 5.30 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

WAISGLASS HARRY J. Mr. Waisglass has had wide experience in applied social and economic research, as a negotiator, conciliator, mediator and arbitrator in industrial relations, and as a consultant on research, policy planning and socio-economic development. On January 1, 1968, he was appointed Director-General of Research and Development in the Canada Department of Labour. Previously, he served as Research Consultant to the Special Planning Secretariat, Privy Council Office, in Ottawa. He had been Research Director (Canada) for the United Steelworkers of America; Education and Research Director (Canada) for the Amalgamated Clothing Workers of America; Lecturer in Industrial Relations and Senior Research Fellow in the former Industrial Relations Institute, University of Toronto. From 1944 to 1947 he worked in Ottawa as a statistician and researcher for the Department of Labour and the Industrial Production Co-operation Board. In 1963-4 he was an International Labour Office consultant to the Singapore Government and trade unions. Mr. Waisglass has served on the Voluntary Planning Board for Nova Scotia (1964-7); the Financial Advisory Committee of the Ontario Government's Development Agency (1963); the Vocational Advisory Committee of the Toronto Board of Education; and on numerous boards of conciliation and arbitration in labour disputes. He was for many years chairman of the Legislative Committee of the Toronto and District Labour Council and on several committees for the Canadian Labour Congress and the Canadian Welfare Council. He has also had long experience as an officer and board member with local private welfare agencies: the Jewish Vocational Service, the Toronto Rehabilitation Centre, and the North York and Weston Family Service Centre. In Toronto, he had many years of service on boards and committees of the United Community Fund and the Social Planning Council. Born and educated in Toronto, he obtained his Master's Degree in Economics in 1948. Author of *Towards Equitable Income Distribution: Some Social and Economic Considerations for Union Wage Policies*, he has contributed articles to *Canadian Welfare*, *Financial Post*, *Industrial Relations Quarterly Review*, and union periodicals. Mr. Waisglass is Chairman of the Interdepartmental Committee on Socio-Economic Research.

CRAIG ALTON WESTWOOD JOSEPH *Date of Birth:* -November 16, 1931 *Marital Status:* -Married, three children, ages 4, 7 and 8 *Academic Training:* B. Comm. (summa cum laude)-St. Dunstan's University, May 1955 M.B.A.-University of Western Ontario, June 1957 Ph.D.-Cornell University, June 1964 (The Ph.D. work was done in the following fields: Major-Collective bargaining, labour law, labour history and theory. Minor-Labour economics and income security, Sociology, with emphasis on sociological theory and bureaucracy) *Positions held:* Field researcher-Economics and Research Branch, Canada Dept. of Labour Summers of 1958 and 1959 Part-time researcher-Cornell University, 1960-1962 Lecturer-Christ the King College (UWO), 1957-1960; 1963-1964 Part-time Lecturer-Huron College (UWO), 1963-1964 Research economist-

Economics and Research Branch, Canada Dept. of Labour, 1964—Chief, Indus. Rels. Research Division—Economics and Research Branch, Canada Dept. of Labour, 1966—Secretary—Labour Department—University Research Committee, Canada Department of Labour—beginning of January 1967—Chairman—Policy Research Group, Economics and Research Branch, Canada Dept. of Labour—beginning of January 1968—*Courses taught*: Introductory course in business administration Accounting Industrial Relations and Labour Economics *Research Experience*: Field interviews on the impact of automation in the Canadian automobile Industry during summers of 1958 and 1959 for the federal Department of Labour. Review of literature and field interviews on automation under the direction of Professor R. L. Aronson, Cornell University, from September 1960 to February 1962. Professor Aronson's publication, "Jobs, Wages and Changing Technology", published in 1965, was based to a large extent on my work. "The Consequences of Provincial Jurisdiction for the Process of Company-wide Collective Bargaining in Canada: A Study of the Packinghouse Industry". (Doctoral dissertation, 1962-64). The Structure of Collective Bargaining in Canada, 1953-1966 — (Data for this study has been put on computer, and a number of publications should appear during the present year.) *Publications and Papers*: "Arbitration of Labour-Management Disputes in Canada"—*Labour Law Journal*, November, 1961. "A Framework for Understanding Industrial Relations Behaviour" (A paper presented to the M.B.A. students at McMaster University, Dec. 4, 1965) mimeographed. "A Framework for the Analyzing of Industrial Relations Systems" (A paper presented to the annual meeting of the Canadian Political Science Association, June 7, 1967) mimeographed. "Perspectives in Collective Bargaining". (A paper presented jointly with Mr. H. J. Waisglass at the June 1968 meeting of the Canadian Industrial Relations Research Institute). *Membership in Professional Societies*: American Economic Association, Canadian Political Science Association, Industrial Relations Research Association, Professional Institute of the Public Service of Canada. *Membership in Honour Societies*: Elected to Cornell Chapter of the Honor Society of the Phi Kappa Phi, 1962.

SAUNDERS GEORGE —Mr. Saunders, who was born in Toronto, March 4, 1928, graduated from The University of Toronto with a B. Comm. degree. He was awarded a scholarship in 1951 to study postgraduate economics at the University of Wisconsin, where he received his M.Sc. degree in 1952 and his Ph.D. in 1959. He was a teaching Fellow at the University of Wisconsin from 1952 to 1954. In 1954, he joined the Canada Department of Labour as an economist. In 1966, he became Director of the Economics and Research Branch of that Department. Mr. Saunders has represented Canada at conferences of the Canada International Labour Organization and the Organization for Economic Co-operation and Development. In 1963-64 he was the Canadian delegate to an OECD group of independent experts in Paris studying the relationship between changes in wage differentials and labour mobility. He also served for six months in 1963-64, on the staff of the Preparatory Committee on Collective Bargaining in the Public Service. In December of 1966 he was seconded for a two-year period to the Prime Minister's Task Force on Labour Relations as its director of research. He is author of a number of papers on wages and industrial relations, is on the executive of the Canadian Industrial Relations Research Institute and is a member of the American Economic Association and the Industrial Relations Research Association.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Thursday, February 6, 1969.

The Special Committee on Science Policy met this day at 3.30 o'clock p.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, this afternoon we are meeting with the representatives of the Department of Labour. The delegation is headed by Mr. Harry J. Waisglass, Chairman of the Interdepartmental Committee on Socio-Economic Research. He is accompanied by Miss E. Lorentsen, Director of the Legislative Branch; Dr. George Saunders, Director of the Economics and Research Branch; Dr. A. W. J. Craig, Chairman, Policy Research Group, Economics and Research Branch, and Mr. J. Mainwaring, Director of the International Labour Office Branch.

Mr. Waisglass, do you propose to make a brief opening statement?

Mr. Harry J. Waisglass, Chairman, Interdepartmental Committee of Socio-Economic Research, Department of Labour: Thank you very much. Honourable senators, we would like to express our very sincere appreciation for the interest that your committee has shown in the research and development work of our department and express also our pleasure for this opportunity to be here and to appear before your committee and answer whatever questions you may have to the best of our ability.

I would like to open first of all, if you do not mind, with an apology for the brief as it is; we have tried to answer as best we can the questions that you put to us. Some of them were rather difficult to answer, but we had to do the best we could under very severe disadvantages, in time particularly and even more so in respect to a lack of senior staff time.

Some of our senior officials in this area have been away, like Dr. Saunders here, who has just completed his tour of duty with the task force on industrial relations, where he served as Research Director and was responsible for organizing and managing the research program for the Woods task force.

He only returned to us quite recently. We have had other senior people away on various missions. One of our people is serving as an adviser, an expert for the ILO in Kuala Lumpur, Malaysia, setting up some statistical programs for them; another one of our senior people in the research area is away on the bicultural and bilingual program for a year.

So with all the very pressing and urgent problems that we had to work on concerning the department, particularly in the matters relating to the work of the task force on industrial relations, we tried to give as much time as we could to this brief.

In going over it we find that there are a few technical errors and there will be some corrections brought to your attention in the form of a revised brief later on.

The Chairman: Do you have those revisions now, because they could be included in our proceedings you see immediately?

Mr. Waisglass: There are a few revisions; it may take up some time though if we were to go over the brief at this point and indicate what the changes are.

The Chairman: It might be confusing to have two briefs in our proceedings.

Dr. A. W. J. Craig, Chairman, Policy Research Group, Economics and Research Branch, Department of Labour: I think the idea was that we would take this brief back and have it re-typed and then there would be only one brief in the published proceedings.

Mr. Waisglass: There is another problem that we face here at the moment, in that the very essential and very important, wide questions which your Committee is concerned with on science policy in the very broad terms are questions which we find ourselves in rather a difficult position to speak to as public servants, particularly because questions of the formulation of science policy are not one of the mandates of the Department of Labour in the sense that we are not officially concerned with the overall formulation of a science policy.

I should say that the Department is concerned very much with the use of social sciences and the application, the development of social sciences, the application of scientific approaches to the solution of the policy problems with which the Department is concerned.

We are also concerned, I and my colleagues here today, as well as several of our professional colleagues in the research and development area, as individuals and as professionals and as citizens with the development of social sciences and particularly concerned with the kind of role that social sciences could, should and ought to play in a most efficient and most effective way, drawing on their skills professionally as social scientists and applying it to the problems of concern to public policy.

There are quite a number of problems which we could discuss in our professional capacities, from the point of view of our professional concerns about the development of the social sciences as distinct from the questions which I gather largely preoccupied this Committee to date, the concerns of a lot of people who appeared before you, the development of the physical sciences.

We are particularly concerned with the development of the social and human sciences; our concern with the development of science and technology in the Department has been more from the point of view of the effect that technological change has upon human, social and cultural adjustments in our society.

The organization of the research and development area in the Department of Labour I think is a matter of interest to your Committee, as I think it is rather distinctive, that the importance of the research and development area is recognized in the Department as a whole, and reports directly through me to the Deputy Minister. It is organizationally separate and apart from, yet, its work is functionally related to and integrated with the work of the operating arms of the Department. A good deal of our research and development work is organized to serve the operating arms and concerns of the Department.

One major area is the industrial relations area, which is concerned essentially with the administration of labour legislation, the Industrial Relations and Disputes and Investigation Act, concerned in everyday language with the prevention and settlement of labour disputes.

The other major program area in the Department is the one that is concerned with the formulation and the administration of labour standards.

In both these areas I should say that the research and development group play a very significant part and provides I think what we should describe in the very broadest terms as an intelligence function.

The Chairman: These are now the two main policy responsibilities of the Department of Labour, as a result of the change which was made in 1966?

Mr. Waisglass: That is right; prior to that the Department was also concerned with manpower policy and programs, which since the beginning of 1966 have been made essentially the responsibility of the Department of Manpower, but there is very close interrelationship between manpower problems and industrial relations problems in very broad terms.

There is also a need for fairly effective collaboration, therefore, between the research program of our department and the Department of Manpower and other departments, more or less depending how they impinge on the problems of the public policy formulation in the labour area.

There is also the third area of branches which reports directly to the Deputy Minister, which are the administration branch, personnel, financial administration, public relations. A certain proportion of our research and development work is related to those functions.

I should say that in addition to this kind of orientation, which is indicated by what I have said so far, the orientation of providing the intelligence services, organizing and delivering intelligence for the decision making processes in these primary responsibilities of the Department, there is also a responsibility of the Department in which the research and development group provides direct services to unions and management which assist them in the formulation of their policies and in the decision making processes in the private sector as distinct from the policy formulation in the public sector.

One of the aims of our Department is that as much as possible the differences between labour and management should be settled by themselves and we, in whatever way we can, by the use of statistics and research help them to clarify and understand their problems there.

This kind of intelligence service, the use of research and statistics that help them solve their problems, or put this kind of information in the hands of third party mediators, conciliators or, in the rare instance, conciliation boards, is useful in providing some of the objective criteria or measures to resolve differences.

There is an area in which perhaps a good deal more work might be done in the future and it is probably a matter of faith on our part, although some of it has been a faith that has been bolstered by experience, that in so far as we can get conflicting interest groups to come to agreement as to what the facts are, makes it easier to settle their interest differences. I think we make a very positive contribution in that way.

Another area of service, and one which has not received a great deal of widespread recognition, but

which I think is one of the very vital, positive, most useful contributions that the Department has made through its research services over a good many years—and there are some of my colleagues around the table who can tell you something more about the history of this if you are interested in it,—is the kind of research and development services we provide in collaboration with the provincial departments of labour, which provide a very useful service in contributing towards the efforts for coordination of activities for the purpose of harmonizing the formulation of social policy in the industrial relations areas.

This kind of voluntary, spontaneous,—I put some emphasis on the words spontaneous and voluntary—collaboration through the intelligence functions of the research and development area as in the past, and I think in the future, can contribute a great deal more towards the formulation of public policy, public social policy, industrial relations policies.

In a country such as Canada, where we have eleven jurisdictions in the labour area, while responsibilities and authority in areas of labour management relationships are divided in that way, the actual problems are not always divided along the ways of jurisdiction. I think that for the purposes of making social progress the kind of collaboration and support services particularly provided by our Legislation Branch and Economics and Research Branch and the International Labour Affairs Branch, which brings into the eleven jurisdictions in Canada an awareness of developments of public policies in other countries, and in agencies like the ILO and OECD, is a very important intelligence function contribution in the way in which research and development services become very significant exchange agencies.

I think in a large sense the services in which our research and development are concerned are not research in the abstract sense, or the pure sense or, as some people call it ivory tower research; it is action-oriented research. It is action-oriented in terms largely of providing the most reliable information and intelligence for decision making.

I might say, if I may Mr. Chairman, I do not want to prolong these opening remarks, but I just think I would like to close now by an observation, perhaps regarded by many of us as a very pedestrian observation, by Stewart Chase, who is a very popular writer on science problems: something he wrote some time ago. I thought this quotation was particularly apt in terms of our concerns here about the role of social sciences and how they might be developed for the future.

Stewart Chase wrote that:

If social science is to be of any use to us it must be capable first of all of adding significance and meaning to human behaviour which will give us a degree or a deeper insight into human life and

explain more fully that common sense knowledge why human beings act the way they do. Science necessarily solves problems; to solve them it must know what questions are involved.

I would like to draw, if I may, some inferences to this: A great deal has been said about the need of keeping research separate from the problems of administration and policy formulation in order to protect its objectivity and for other reasons science ought to be developed in its pure sense.

I think that it is very important, and we try in our department to bring objectivity and a very realistic and honest assessment of what the facts are and bring them to the attention of the decision makers in a way in which they can be most useful to them. We honestly believe that if research in these areas were separated too far from the decision making processes they cannot really be effectively useful.

It is important to have a very close relationship. Having them together, as we do in the research and development area, gives recognition that research is done best in a research and intellectual environment, but is still within the department and very closely related to the concerns of the decision makers and the administrators.

It is necessary to have this kind of inter-action because as some scientific observers, sociologists particularly I have in mind, have noted, administrators and policy makers do not always ask the right questions.

On the other hand, the researchers are not always concerned, working by themselves, with the kind of questions that the policy makers are concerned with. By bringing them fairly close together, yet keeping them separate and giving them a reasonable degree of autonomy and self sufficiency within your organization, it is possible to have a kind of environment in which the researcher can give the administrator and the policy maker a wider perspective of problems, and in turn, the administrator can give to the researcher what I like to call and which is very useful to the social science researcher, the reality component.

I think that is about all I should say at this time, Mr. Chairman.

The Chairman: Thank you very much. Senator Thompson?

Senator Thompson: Mr. Chairman, I would first like to say to Mr. Waisglass that it is refreshing to hear a scientist who is suggesting the dangers of being purely abstract and the necessity to have action-oriented research. I should say, Mr. Chairman, I have known Mr. Waisglass for some time. I know he has had this refreshing approach and I think as he

said this information, intelligence and objectivity to the solving of community problems.

He has just referred to one where he applied research in order to get more efficient and successful medical resources to communities and I am sure there are many others that he could state.

I wonder, Mr. Waisglass, perhaps with my previous background in listening to political speeches—

The Chairman: Do not forget that you were a civil servant too.

Senator Thompson: And I was a civil servant and had to write some speeches as a matter of fact.

In your first page here you refer to the fact that the basic objectives are to foster economic and social progress with justice through the promotion of good industrial relations and improved working standards and benefits.

Economic and social progress with justice; they are rather high faluting platitudes in some ways; would you like to qualify that to some extent for us?

Mr. Waisglass: No; the best I can do is put this in my very own ordinary words, what they mean to me; if they mean something else to my colleagues I hope they will chip in.

There are a good many departments of government that are concerned, and quite properly, with the expansion of production. This is their primary, if not their exclusive concern and they are concerned with the inputs for production and for productive efficiency. One can regard labour as one of the important inputs and I suppose the Department of Manpower in the kind of programs and services which they are organized to deliver is concerned largely with the quality, the skill of labour and seeing that the right skills are there at the right time for the production processes. They are concerned largely with the quality of labour as an input.

Scientists who have appeared before you, researchers from other departments, I think would be largely concerned also with technology and science input in the production system to produce bigger pies, better quality pies.

We are not primarily concerned with that, although this is a very necessary part, to have economic expansion and growth. But I think that at least one department in government ought to be primarily concerned with what comes out of the production system: the distribution of production rather than the size of production, the inputs. So that I would say that the things with which we are primarily concerned are the equitable distribution of income; we are concerned with the questions of how problems are solved between unions and management in the

form of making private decisions and private bargains; how they affect the overall public interest.

Private interests in this country, as everybody knows, are pretty well expressed. I think that in this area it is a very legitimate function for the Department of Labour to attempt to articulate and express what the public interests are and to seek to develop a harmonization of public and private policies that will make for a just society.

The concerns of a good many people in the industrial relations field are, quite naturally, often centred exclusively around the question of wages, as being one of the outputs that labour gets from the production system, and I think it is very important.

One of the things that we are concerned with in this area of the outputs of the economic and social processes, is the non-monetary satisfactions of a worker, with his happiness and with his well being and with the kind of satisfactions he can get on the job and in the community.

Our concerns are not limited, I should say, with the well being, economic and social, of the unionized worker. It is all of the workers we are concerned with; the kind of legal or legislative environment; and the environment of organizations and institutions; what we can contribute through our research and development processes that could facilitate the development of organizations which will help individuals in their own self realization as citizens and as members of the family as well as productive workers.

Senator Thompson: I wonder if I could follow just on that and thank you for that statement; I am thinking of your concern not just with the working conditions but with the whole aspect of recreation and leisure time for the workers.

I have been interested and I notice that you have done some studies on technological change; I will come back to the point I was making at a later time, but on page 29 you have had, for example, a study on the response to technological change, technological changes in the railway.

On page 31 you talk of technical innovations and collective bargaining and then economic and technological change in the 1960s.

Then on page 38 you talk of studies on the impact of technological change.

About five years ago I can recall, I think it would be about five to eight years ago, there was perhaps almost a feeling of apprehension or indeed of hysteria towards the impact of automation in our own Province of Ontario and the government had studies on this. The Minister of Labour assured that it had little influence in respect to unemployment, but I think it has other changes, and I would just like to

quote this. This is from the *Science Journal*, an article called "Automation and Leisure", by Otto Neuloh. I will just refer to one short paragraph where the author suggests that a social change to a community based on government service or administration is the probable effect of automation on society. He is referring to about the year 2010 or so.

Do you look ahead in order to forecast what problems are going to take place and would you agree with this implication that he is making?

Mr. Waisglass: Well, I could not say whether I agree with his implications or not, because I am not familiar with the background of the research there, but I would say that they are problems that we are concerned with.

In terms of the research work that is being done within the Department itself, because of the shortages of staff, we give more of our attention to the immediate problems and the kind of problems we can anticipate in the near term and to ready ourselves to face anticipated problems.

The very long term problems, unfortunately we do not have the resources to do as much with them as we would like. This is a very real problem that requires a great deal more attention than we have been able to give to it.

However, we have now a fellow we have sponsored who is doing research work in Geneva at the International Centre for Labour Studies. Mr. Craig or Mr. Mainwaring could tell you more about that particular program, which has been going on for some years. We generally send one, sometimes two fellows abroad to carry on research work, to further their research work.

This particular man has done some considerable work on the relationship between changing technology and leisure and worker participation in the affairs of his community, the effect of the growth of technology, the reduction in working hours and therefore the greater leisure time. How is man going to use this? What opportunities does it open up for his participation in creative activities in his community?

Now, I do not know much more detail about that study, but Dr. Craig can tell you more about that.

The Chairman: But in engaging your research branch in this kind of research is there not any danger that you might invade the field which is now the preserve of the Department of Manpower, for instance?

Mr. Waisglass: We do not see that; the manpower people have their own grants programs for research. One of their people, their Assistant Deputy Minister, Mr. Dymond, sits as a member of the Advisory Committee in which we judge each of the applications,

so we are quite sure there is not a duplication of work.

Particularly, there are certain frontier areas for research and this is one that does not fall that clearly into one person's jurisdiction rather than another's. It needs to be done and I think a great deal can be said to encourage able scholars who can do the pioneering work; once they have a solid basis established for it, then perhaps other resources can be put to it at a later time.

Senator Thompson: There have been crises in our labour history where we had not looked ahead in order that we can plan how we are going to deal with problems; we deal in a crisis situation.

In this article it says the medical profession, backed by other scientists as well as by employers, have also advanced the theory that the provision of summer and winter holidays is more necessary and more effective for the physical and mental recuperation of the worker in the long run than a long week-end or shorter working day.

Now, we see labour, for example, I am speaking of unions at this point, arguing to a large extent for a shorter work week.

In Germany they are looking at the shifts that are taking place, three shifts, four shifts sometimes. They are changing television programs to adapt to this, church services, a whole variety of things.

Now I understand that they are doing studies and saying rather than just giving a short work week because of the impact of technology, let a man have two months off to recuperate and spend more time fixing up his garden and so on. I think it is the sort of thing we should be doing.

I would like to move from there into the point that you have made throughout your brief, that you do not have enough staff. I was interested to notice that in your contracting work out and I am thinking of page 16, it shows that you are cutting down in this contracting work out; there were three areas.

At page 25 you refer to the limited number of projects; on page 16 the grants were decreasing, and there was another page actually stating contracting out. I am sorry I do not have the page which listed the contracting out grants, which I think was \$50,000.00.

If you do not have enough staff yourself why do you not extend your contracting out to get this kind of work done?

Mr. Waisglass: We have moved in that direction; there has been a fair amount of research work under contract. There is a very important limitation on that; that is budgetary resources. It depends on how

much funds are made available. That is just one limitation.

Another very serious limitation is the availability of skilled, applied social scientists who will concern themselves with these kinds of problems outside of government.

Senator Thompson: Let me take another example: Surely this Department should be the example of being able to develop the approach that perhaps should be used by other government departments and indeed by industry.

You give grants to universities and yet in your brief you are referring to the fact that you are not getting trained people to do this work.

Is it because the grants are too small, or that you are confining them?

Mr. Waisglass: I think first of all we have to look at the positive side of this; the grants program over the years has been very useful in developing a body of scholars, people who might be interested in industrial relations work and research that is not necessarily immediately concerned with the day to day problems of the affairs of the department, but in the industrial relations area.

There are a number of people, if you take a look at the kind of people who have received grants from us in the past, a good many of whom have become very prominent in the field and have made very important contributions.

Professor Meltz, Dean Woods, Dr. Sylvia Ostry, a number of people who in the early stages of their careers in the industrial relations area did get grants from us and made significant and original contributions in this field.

The important thing is it was not just the particular problems that they were able to solve that they got the grants for, a particular contribution to the body of knowledge. The real performance was largely through their getting people involved in different skills and developing a competency, an individual competency rather than an institutional competency. I think it is a very important distinction to make.

We have succeeded to some extent in developing some individual scholarships, individual capabilities in this field, that we might not otherwise have had. I cannot say if it would have been developed had the Department of Labour not been there in the years providing these kinds of grant funds. That I do not think we can answer, but we have the conviction that it did contribute something.

From a ministry point of view now—when you have some shortage of funds, there is a scarcity of resources—the very natural inclination is that you put your resources, you organize your resources in

such a way that you can deal with and cope with the immediate problems, rather than the longer term problems. We have got some very important and urgent problems that have to be solved today, some very critical public policy issues.

You are going to give your resources to using your people in the best way possible. Even if they are mediocre people, they are the best you can get. You get them to help you with your problem and you give less of your funds or your resources to the development of the long term resource capabilities that you would wish to draw on in the future.

From time to time, it is not always that way, from time to time there is a scarcity of resources in relation to the demands for them so we make compromises for today; we hope we will be able to solve the long term problems in the long term.

Senator Thompson: Just jumping to another area, you talk of social justice. I know you feel personally strongly about this and that one of your roles is to look at the working conditions. I have a feeling though that for the most part you are orientated to the people who can best look after themselves, that is the organized people in unions.

We have real problems in our society today which have been there for a long, long time: The migrant farm worker and the deplorable conditions under which he lives. I would be interested to know if your Department has done a study in this kind of area? The mentally retarded and particularly in relation to the increased technology and the increasing difficulty for this person to get any kind of work. I think of the conditions of the people working in an asbestos plant.

I am not satisfied, frankly, from the people on atomic regulatory bodies just how effectively they are doing on the effect of radiation on workers.

I could go to a number of hazardous industries, but these are not under any collective bargaining agreement in some areas, I refer again to the farm workers now, there are a lot of people who are not under collective bargaining agreements, yet your main progress is to get to the first two areas.

What about all the unorganized workers?

Mr. Waisglass: Mr. Senator, that is a question that I really appreciate very much; I agree with you in some respects, but the fact that we are giving attention only to the organized workers is not fair. That is not so.

The industrial standards side of the Department—setting minimum wages, maximum hours and vacation provisions—is designed largely to provide some essential protection to the non-organized worker in minimum standards.

However, if you carry your question further about the non-employed workers, the drop outs from the main streams of economic and social life of this country, the hard core, the farm worker who is really unemployed most of the time—and there is the marginal worker, who has really a very tenuous connection with the labour forces—I must confess that it is something that has pained us that we have not been able to do as much work in that area as we could.

There is a problem again of dividing this: Who is really responsible for work in that area? Is it a problem for health and welfare people? Is it a problem for the Department of Labour?

The Chairman: Or Manpower?

Mr. Waisglass: Or Manpower. Here you come to areas of how do you get these drop outs from society back into the main stream?

Now, we do have some programs in that area; our Fair Employment Practices Act and our Fair Employment Practices Branch.

There is a need for a greater research support to be given in that area, which we have been giving attention to in developing some programs for research in that area and some activities in conjunction with other departments in other jurisdictions, the provincial field.

Here is an area that requires, I think, a great deal more attention and an area which requires a great deal of collaborative effort between various departments and jurisdictions.

Senator Thompson: Have you done, for example, a comparison of the life span, of the types of illness and amounts of illness of a man working say in one industry which we call a hazardous industry instead of another industry?

Mr. Waisglass: When it comes to industrial accident research there has been some work done on that. The safety branch on their own, and some of it under contract, and some in conjunction with our own program area will be looking and has done some work and will be doing a great deal more work into safety conditions, largely again in industries under federal jurisdiction, such as transportation.

There is work like that being done provincially as well.

Non-industrial accidents and sickness problems is an area for research in the Department of Health and Welfare. We do have an interest. Now, there again you see there is a problem, a very vital problem that we are concerned with, but again it is a question of time and many resources to start looking at these areas that are marginal.

There has already been a good deal of research done to set up some hypotheses, a conceptual framework for further investigations on the relationship between mental illness, emotional disturbance and the problems of adjustment to change.

Here is an area that to a large extent industry is more concerned with: the successful adaptation to technological change.

One way of looking at poverty, the way in which I look at it, is largely looking at the problems of people who for various reasons have been incapable of adjusting to technological and economic changes because of either physical reasons, disabilities, shortcomings, mental or emotional. These are problems and these problems are very much related to what goes on, the changes of industrial civilization and the effects on human organizations and the capabilities of adjusting.

I think a great deal more research could be done in that area. There is a great deal more to be done to formulate the questions for researchers, to be sure that we always ask them the right questions.

Now, again, here it comes into an area of how far does a labour department legitimately go into research in these areas which also involve inter-disciplinary as well as inter-departmental concerns?

Senator Thompson: If you do not go who would go?

Mr. Waisglass: There is a good question: is it a field for the research of psychiatrists, psychologists, or is it a field really to mount an inter-disciplinary attack on this kind of problem, on the effects of change on people, and particularly those who become drop outs from our society, who are incapable for various reasons to adjust to these kinds of changes? What then can be done to bring them back into the main stream of life?

Senator Thompson: Can I turn the question back on you: Do you think it is an area in which your department should be doing work?

Mr. Waisglass: My own personal view is that it is an area which we should be concerned with, but at all times we have to make decisions on priorities. I would like us to have the resources ultimately to be able to do more effective work in the kind of areas where we can make, I think, contributions for public and private policies.

Senator Thompson: I was interested to see John Porter has done a study; I am not sure of the title of it, but I think it was with respect to the attitudes towards various locations. We are interested in the need for scientists; we have heard that young people look on scientists, some of the young people look on scientists as being immoral because of the atom bomb and so on.

Does John Porter deal with that in his study?

Dr. Craig: Yes, he does deal with the ranking of different occupational groups and if I recall correctly social scientists did not really come out high in the ranking.

Senator Thompson: I am not thinking of social scientists; I am thinking of physical scientists.

The point was made to us by one of the Americans who came as a witness that they considered one of the problems of young people entering science is the revulsion that they have towards the manufacturing and the use of the atomic bomb; they do not want to associate.

I had wondered if John Porter had indicated there was any such reaction on the part of young Canadians?

Dr. Craig: He did not indicate any such reactions. Of course, his study was done two or three years ago and it was presented as a preliminary paper at that time but if I recall correctly most of the scientific disciplines ranked fairly low in the hierarchy.

If I recall correctly, political occupations ranked much higher; the medical occupations, doctors and so on, these ranked much higher than social scientists.

Mr. Waisglass: I would like to modify, if I may, an answer which I gave to your last question:

On further reflection, in respect to your question about whether this is a legitimate problem for the Department of Labour to do research on the areas of human adjustment to technological change, I would like to modify that answer. I think it is more legitimate if problems like that were worked on on an inter-departmental basis, rather than a purely departmental basis.

I think that the kind of research that has to be done in areas like that has to reflect a more integrated approach to the kind of policy problems that face us in these areas.

Senator Thompson: But it could be initiated and coordinated by the Department of Labour?

Mr. Waisglass: There could be some initiatives taken but there is always a problem here in the way in which government is organized to solve problems, but it is difficult, to say the least, to initiate research programs that require inter-disciplinary and collaborative effort when the problem itself does not fall clearly within the jurisdiction of one part or one agency of government rather than another.

The problems of initiating research effort have to be related to the problems of management and problems of formulation and administration of policies.

I think that in my experience, especially in the first year that I was here in Ottawa and working with the inter-departmental committee on social and economic research, I saw that one of the serious limiting factors on inter-departmental collaboration was not entirely, although there was some aspect of it, the lack of experience and the lack of skills for various disciplines to work together. You know, the traditional disciplines within the social sciences and between the social sciences and physical sciences; there was a great problem there.

One of the limiting factors here as well was the problem of planning and managing the functions of departmental coordination.

If I may give a 'for instance': as I see it, prior to the establishment of the new Department of Regional Development there were a number of agencies who were concerned with regional development problems and each of them had their own research staff and research services that they draw on. Many of them had a lot of their research done under contract, rather than by inhouse staff.

There was a great deal of difficulty in trying to coordinate the work of research in each of these separate autonomous agencies and it was only by bringing these agencies together into one Department of Regional Development that it is possible to have a larger scale coordination of research between various departments. Otherwise each agency has its research work organized in terms of the way in which that agency sees its particular mandate and problems.

If you can devise some scheme, or innovate some forms of organization for the coordination of research responsibilities of various departments in an area it facilitates the coordination of research in that area.

The Chairman: Could you tell us a little bit more about this inter-departmental committee on social and economic research?

Mr. Waisglass: As I understand it, it ceased functioning some time after I left. It may have had one or two meetings since then.

The main reason why it ceased operating was that the special planning secretariat in the Privy Council office was transformed and integrated into the other services of the Privy Council office. I was there just for a year as a consultant and was instrumental in bringing together the senior research people in various departments who are concerned with socio-economic research.

It was largely an exploratory exercise, initially to have the research community in the various departments and agencies of government to be able to come together and identify the problems, to be able to articulate what are the problems for coordination of research, to express the needs for it and then see

what kind of efforts can be mounted on a voluntary basis.

Perhaps this experience is one that is worth looking into. What we tried to rely on to a large extent was voluntary cooperation of research between voluntary agencies; there was no mandate, no requirement or authority, requiring them to integrate these things. But you see what kind of collaboration you could get on your own.

This kind of thing I think is possible; it requires a great deal of faith, a great deal of time and a great deal of patience, but it is very slow until you have some authority commanding integration and coordination.

The Chairman: But why did the committee disappear? Because you were not making any progress in coordination?

Mr. Waisglass: I think that further progress might have been possible, although slow so far and perhaps costly, if someone was brought in to replace me, or people were appointed to continue the effort.

It is largely the kind of effort that relies largely on persuasion, rather than coercion; it is a matter of getting people to sit down and see what the problems are, to see if they can work out some solutions.

I should say that, as far as I could see, the results were not entirely discouraging; there was some considerable progress made.

As a consequence of the work of this committee I think for the first time we were able to bring together all of the administrators of grant programs in the socio-economic sciences and, in consequence of that, we produced under my direction a book listing all of the grants of the various agencies in the social sciences.

For the first time the administrators of grant programs got together and were able to exchange experiences and views on problems

Many of the problems remained unsolved, or many of them could become aware what the differences are and learn to accept the differences and say "perhaps because of the nature of our program we can justify the particular difference, we have to be different from everybody else". There was an attempt made there to bring together information on the grants programs.

The design that I had in mind at the time was that we might move further; after we were able to get some voluntary pooling of the information among administrators of grant programs the next step would be to try to see if we could bring together the administrators of contract research programs in the social sciences and get a pooling of information there.

The third step would be to get people who are administering in-house research programs and bring them together.

The fourth step was a monstrous one and I would have hated to face it, of bringing together all the information of what research has been done on Royal Commissions and the task forces, which is a tremendous thing in itself.

That would, say, cover horizontally within the federal government; we had in mind after we did it at the federal level to see if similar efforts could be made in bringing together information about governmental research in the social sciences at the provincial level and in the non-government sector, so that we could probably get some kind of a grid worked out. It was a piecemeal approach; in the course of work with this we attempted to get people working with a view to see if something more . . . I should say a grand design of working towards some kind of an information centre or a clearing house for research and research results, what goes on in the social sciences, so that people can tune in or tap in when they are facing problems and see what the experience is and what has been done in that particular area.

Senator Thompson: Without such apparatus in the government, am I fair in suggesting that there must be overlapping, duplication and inefficiency?

The Chairman: And perhaps as Mr. Rasminsky told us the other day, important gaps?

Mr. Waisglass: I was going to say, Mr. Senator, that I am much more concerned, at this stage anyway, about the gaps than I am about overlapping.

The Chairman: In the field of the social sciences?

Mr. Waisglass: In the field of the social sciences.

I should, if I may, draw to your attention one other personal impression. I will put it as nothing more than that.

I found that while there were a good many resources available from federal departments and agencies, and particularly the Canada Council, which has been a tremendous thing for the promotion of individual scholarships, there are sums available for an individual effort or there is money available for institutions to do research in the social sciences, if they already had a capability of doing it, in the case of institutions, but there are many areas for social research in this country requiring an established institutional capability, particularly in inter-disciplinary areas where it is necessary to have that institutional capability, to have the basic foundation work done of working out an institutional framework and the

methodology for research. Unless that is done you cannot get good contract research.

There are a good deal of examples of agencies which got money for contract research, largely because they were the best ones around, but they did not get good results and they contributed nothing in many cases. Getting these contracts contributed nothing to the development for the long term of that institutional capability for the social sciences.

I say that perhaps there is a need for some kind of mechanism or machinery to establish some centres of excellence.

I do not think that in a country like Canada we can afford too many; how many centres of excellence can we have for research in urban problems, or research on problems of industrial relations or survey research centres?

There are a number of things, so many things that we need. But how are we going to develop some of these institutional centres with their capabilities to accept particular problems from government and from various levels of government, not just the federal government, to be able to apply a disciplined organized and systematic way of dealing with those particular problems?

Senator Cameron: Mr. Chairman, first I make two observations: One, knowing something of Mr. Waisglass' background and how active and dynamic he was when he was a member of the steelworkers and so on, I have been surprised at the way that the Ottawa atmosphere has inhibited and quieted him down.

Mr. Waisglass: Shame on me.

Senator Cameron: The other thing is that I think that what you have said in reply to Senator Thompson emphasized something that has come out time and time again in the hearings of this Committee; that is the tremendous lack in the program of social science research in Canada.

Now, your work is mainly in that field and in looking at the numbers of people employed in the last 5 or 10 years I think it just increased about two in your research staff in the period of time the labour force has increased by a good many thousands, the problems have become increasingly complicated.

I am wondering if you think there is any possibility of doing an effective job in the area that you have responsibility for with the kind of staff that you have at the present time? You might as well be perfectly frank?

Mr. Waisglass: To be frank, I think that we are getting tremendous results, suprisingly good results from

the staff we have got; I am not always sure that numbers is the answer. I am not concerned with just building up another bureaucratic empire; maybe I am just too new to the Ottawa environment.

We are looking for though, and we continue to look for really competent people. We are caught in a really vicious circle here and unless we can do more, unless more can be done, whether we or somebody else do it, to develop the kind of social scientists who will be concerned with public policy problems and apply their knowledge, their techniques, their know-how, their approaches to public policy problems. No matter how much money you have got you just cannot get them.

On the one hand, I do not see that there is an ample supply of that kind of social scientist.

On the other hand, the other part of our problem is getting enough money to hire all that we would like to have.

There is another aspect of the problem; we have to give, I think, some priority attention to it at this stage, which is the question of developing—and we have. I had some experimental work on this too—developing an efficient, effective organization to manage the intelligence functions so that we can bring research to bear effectively on public policy problems.

There is also something to be said for having a rather small but very highly competent research organization, a very flexible one that can turn its attention from one kind of problem to another, relying more on experts at the universities or in private practice and non-government research institutions, to bring them to bear on particular problems that face you at a particular time.

This gives you flexibility to be able to work simultaneously at immediate term problems as well as long term problems, but that requires some attention from, I would say, policy planning in the social sciences at a much higher level than the level of the department.

Some of these problems are not easily solved just within the framework of departmental organization.

All I could do is give you some thoughts that bear on that.

Senator Cameron: Looking at this list of papers that have been prepared, it is a very large number of papers on various topics prepared by university professors and others.

Then I relate that to the fact that you say that your program is an action-oriented research program and I am wondering how much action results from these papers. There is a good deal of useful background information represented in these studies, but I am wondering when you talk about an action-oriented research program just how much action you are get-

ting out of these papers in boring in on certain specific areas?

To me, and I could be quite wrong in this, I have the feeling that it is pretty diffuse; I have no doubt that all of these questions are pertinent, they have a place, they have a bearing in the labour relations field today but looking over it there seems to me a great deal of diffusion of effort.

The Chairman: Are you referring more particularly to the grants program?

Senator Cameron: Yes.

The Chairman: Or to the research that is done in-house within the department?

Senator Cameron: It is this grants program and I am just thinking when you used the term action-oriented research; how much action is coming out of this?

Mr. Waisglass: On the grants program, it is designed largely to promote more or less free scholarship in the general areas of concern to the department. The scholar identifies the problem; we do not pick it for him.

In contract research it is the problem that comes out of the concern of the department, the problems that we are faced with and we will give contracts or assign research people to the problem.

Most of the action-oriented research is done within the Department, a small part of it by contract.

The grants research is more concerned with the development of scholarship and capabilities for research.

Once these people get that kind of research and experience and we get them all sorted out, the good ones from the bad ones, then we hope that we know who we can draw on.

Senator Cameron: I expected that would be the answer; I wanted to make sure of that.

Now we will go to the next step and here I am speaking as a layman and ordinary citizen and watching the program of the federal government in the labour relations field.

You have on page 36 items 88, 89 and 90; these are pretty important problems that you are dealing with, but what sticks in my mind is we have had some trouble in the postal department for some years; we have had some trouble in the Air Canada employees; and some three years ago we had the Montpetit report come in and it made certain recommendations. Relatively few, I think in the last year or so about 25% of the recommendations had been implemented and the people in Canada have been subject to threats of strikes, or slowdowns, or work to rule.

I am wondering, this may not be within the purview of the research department, but I think it should have a bearing: What studies have been made on the root causes of this kind of discontent?

Mr. Waisglass: First I should point out that, as you know, the Montpetit report said the problems in the post office do not fall within the jurisdiction of the department. Fortunately for us I suppose that is a problem still for the Treasury Board, but the general problem, if I may speak to it in general, is what are the root causes of unrest? Why do men strike? What are the causes of strike? What are the processes for resolving conflicts?

Senator Cameron: That is right, but I do not care who is responsible in the Treasury Board; your department is responsible for research in labour relations. I think that the government of Canada, whatever department is responsible, the Treasury Board or whatever it is, what is behind this? Are there some fundamental things that are being overlooked?

I think probably there are, but the net result is that there is a feeling abroad and it is very general and it is getting stronger that under the revised structure in the department of Labour and the Department of Manpower we are not getting as effective results as we were getting under the old structure.

This is an administrative problem rather than a research problem and I should say that I am sympathetic to the imaginative approach of the Department of Manpower, but there seems to be a lack of coming to grips with certain basic areas.

For example, not so long ago we had the airline people talking about working to rule; we have the postal people talking about working to rule and the effect of working to rule is poorer service to the public, which suggests to me that there is something wrong with the rules.

In other words, this is a management problem, that if those rules that men can follow and the result of following them is a deterioration in public service, the rules should have been thrown out long ago.

Now, I do not know whether this comes within your purview or not, but I think that somebody should be responsible for looking into what happens when groups say we are going to work to rule.

The Chairman: It would certainly be within your terms of reference, because you study the steel industry and you study the pulp and paper industry, so that the federal department or a federal government agency like Air Canada would certainly fall under your terms of reference in this kind of research field.

Mr. Waisglass: Rules I might say, Mr. Senator, generally tend to be inflexible. I defy any management to

design any set of rules that if followed would not lead to those kinds of problems.

If rules do tend to be flexible it is wisdom, it is good relationships, it is creativeness and goodwill that enable adjustments to be made by people to meet particularly changing situations.

Rules have to be changed every day if you are going to live by the rulebook in a changing world.

In terms of your general question earlier about research into the causes of strikes, we have a research program, it is a long term program, there will be some publications coming out, interim reports in the near term, but it is a longer term project and a lot of that work is being done under Dr. Craig's supervision and I can have him tell you about that, if you wish.

Dr. Craig: May I just say a few words about this. We were talking a short while ago about research in the social sciences.

It is only recently that we have been able to attract a highly qualified person, Dr. Garfield Clock, who was trained in the U.K. and who had some experience in conducting studies into industrial unrest in the U.K., unrest taking the form of strikes and a good many other forms.

Since he joined the Department a year or so ago he has been studying our strike record and will be coming out first with a chart book on strikes.

He has also done a good deal of theoretical work in the field of strike causation. With his current research, combined with his knowledge of the theoretical bases for strikes, he will then be coming out with a monograph which should be able to give us a much better understanding of strike behaviour than we now have.

Strike behaviour and other forms of industrial unrest such as slowdowns, work to rule, absenteeism, these kinds of things will be studied, but this is a long term project on which we have one man with capabilities in that area.

The Chairman: If he goes then your program stops.

Dr. Craig: Right.

The Chairman: Almost like you as the chairman of that committee; you left and the committee stopped.

Dr. Craig: I would like to come back to one of the questions which was raised a while ago. My colleagues and I agreed among ourselves that we could disagree before this committee as individuals.

The Chairman: That is very interesting; that is the first time probably that it will happen.

Mr. Waisglass: We try to conduct a research environment.

Dr. Craig: Mr. Waisglass indicated that he felt that we had sufficient resources with the small professional staff that we have. My feeling is quite the opposite from Mr. Waisglass'; I feel that we do not have the resource capabilities for the constant in-house, long-term research that we should be doing.

I think we should be forecasting what are going to be the likely developments in the future and developing a research model which will predict what kind of behaviour will be current in, say the year 2000 by doing some anticipatory research.

What kind of problems are going to emerge and what kind of programs can we come up with that will help solve these problems?

Now, attached to our brief is a work which I developed myself, which is still at a pretty crude stage of development. It calls for what I call a multi-disciplinary rather than inter-disciplinary research approach to problems.

The kind of training which this approach calls for is one individual who has capacities in economic, sociology, and the other social sciences combined. An individual trained this way could grapple with problems or could manage research programs with particular specialists investigating various aspects of these problems and could bring the individual studies into some total package which has all the concepts and theories integrated. Having that overall understanding, then we would be able to develop some kind of nationally oriented program.

I took the liberty to disagree with my colleague; we came to this table with the understanding that we could disagree among ourselves.

Mr. Waisglass: I hate to disappoint the senators here, but there is no real disagreement there.

The Chairman: I was about to say as chairman it was very refreshing.

Senator Cameron: Let us keep this thing tied down to a very practical illustration.

The disaffection in the postal department is a matter of long standing. There was trouble before the Montpetit report came in and this was I thought a very good report, because it recommended the abolition of some feudal rules; it was just simply disgraceful, some of the things, so I was sympathetic to the postal employees.

We gave them a 23% wage increase, I think that is the figure, and here we are subject again to threats of strikes and the talk of work to rule. There is something wrong there, so the Department of La-

bour has not come up as far as the public is aware with any analysis of what is wrong.

Are these union men, like Houle and Decarie and the others, completely unreasonable? Sometimes they sound like it when I listen to them on the air, but remembering the grievances and the injustices that went on in that department for years I am not sure that they may not still be right, but it does not sound like it.

The net effect of it is that the people of Canada are being short changed by this sort of action and it seems to me that the government of Canada should be one employer that should err on the side of being the most effective and progressive in dealing with labour problems; this suggests that it is not.

The Chairman: Is there a kind of arrangement which would have the effect of you not getting involved in research in a federal department?

My sentence is terrible, but do you get the point?

Mr. Waisglass: I am not sure that I understand your question.

The Chairman: Well, would you be expected normally to study the activities and the situation in the post office department?

Mr. Waisglass: Not without the consent of the Treasury Board.

The Chairman: It is not like your other research activities outside the government, where you are free?

Mr. Waisglass: I would not say that we are entirely free to go and research anything we want to.

If you look at the Treasury Board in this area in its role as the employer, we cannot go and study the industrial problems in the Ford Motor Company or in the Algoma Steel Plant or even in terms of our own jurisdiction, seeing what goes on inside the plants, without getting the clearance of both the union and the employer; we have to have their cooperation.

So this is not an alarming problem; it is one of the little things that social scientists have to learn to live with, being able to take their research to the human relations area and the situations. It is the kind of problem that the physical scientist can study in a laboratory; he can create the artificial conditions and study them. We have got to go into the real situations and it requires a great deal of tact, many of these situations, but there is a great deal of research also and we do a great deal of it that does not require that kind of internal investigation.

Some of our work is done by way of surveys, by questionnaires; there is a certain amount of case studies that we have done where we have won acceptance by both unions and employers. There is a great deal more that has to be done in the way of case study.

Senator Thompson: I would like to come back to Senator Cameron's point: Surely the government of Canada should be setting an example for every industry, otherwise it seems to me sort of arrogant for people to go out and examine the Ford Company if they ask you to when you have not cleaned out your own stables, so to speak.

I notice here you have one of your objectives to maintain good standards of wages and working conditions, achieve equality of job opportunity for all workers. I cannot help feeling that there is a reflection on government and on your Department for a situation such as the post office has permitted with respect to standards of wages and working conditions if that has been continued over the years when this is a department that is meant to be looking to see that working conditions are of a high level.

In other words, I am suggesting that if you have not got the authority to go in then there is something wrong with the government.

Mr. Waisglass: No, but we can in our role as a department of labour in terms of the kind of objective data and research that we provide as a service to the Treasury Board as an employer and to the unions in the public service, in the same way as we do to all employers and all unions in the country.

For instance, there is the Pay Research Bureau of the Public Service Staff Relations Board, which is the neutral agency between the government as an employer and the public servant and the unions.

Now, we have very substantial programs of work that have been going on: the collection and analysis of collective agreements, wage data, working conditions, surveys which we provide to other employers and unions, and we provide them to this government and other governments as well.

This is one of the services and I think a very highly valued service, which is provided by our Department.

Senator Cameron: Mr. Chairman, let me get down on this again . . .

Mr. Waisglass: And it is current; it is up to date.

Senator Cameron: Here is the Government of Canada, whether it is the Treasury Board or whatever it is; they have not asked you as the research department for the Government of Canada to do anything in

trying to assess what is the trouble in the postal department; is this a fact?

Mr. Waisglass: I am not prepared to answer that question at this time. They may have at times asked us in specific instances; I do not know.

Senator Thompson: Mr. Waisglass has just been with the Department for a short time.

Mr. Waisglass: I seem to recollect that there have been some contacts between the officers of our department of the Labour Management Consultation Branch with both the employer and the union side in post offices in certain regions. There have been some contributions made in that area of perhaps implementing some of the ideas of the Montpetit report and getting consultations between employers and the unions established in that area.

I think there has been something done; there may be others. I would not say that we have not done anything, but our approaches—I would make this very clear and I know this to be the attitude of the Minister and it is reflected by your question, the idea that you express, and Senator Thompson—is that the cook should be the first to taste his own soup.

I think this is something that our Minister believes and our program for labour management consultation, the programs of the Department of Labour for labour management consultation itself, are ones that he feels ought to be established—whatever contribution we can make in Crown agencies in government departments.

This I know is one of his convictions. I know that from him personally and I think that as far as the policy of our department is concerned, our services, both operational and our research services, are available. It is up to the employers and the unions to make the best use of what services we have to offer.

Senator Cameron: Let us take the analogy of a private company: Suppose this was the Ford Motor Company and they had a problem like this. I suspect the first thing they would do would be to go into their research department and say, "look, find out what the trouble is here; is there something we are overlooking?" I think that we should expect the government to function much in the same way, that they should take their research machinery and turn it loose on this to find out what is the trouble, because this is getting to be very serious and it is having a very bad repercussion throughout the country, the threats of strikes and so on, in this one department, every month or two.

So I am trying this into your action-oriented program; here is a place that is crying for action. I am not blaming you and from what you said I think it is right square on the shoulders of the Treasury Board; they have not asked you to do anything in this respect.

Dr. Craig: Mr. Chairman, I wonder if I could just add a further comment in line with the basic question Senator Cameron raised: Why do we not know more about the causes of industrial conflict?

One of the difficulties with action-oriented research in the short term is that as your problems change so do your research priorities change. Take the immediate post war period when we had a great many strikes both in Canada and the United States. A substantial amount of research on strikes was done up until the early 1950s and we were at that point beginning to get an understanding of strikes and various forms of industrial unrest. With the recession beginning in 1954 and again in 1957 manpower supply became the crucial problem. Then all the resources there were for research in the labour field were turned to the manpower side so that the basic understanding we had started to get in the early 1950s on strike causation we did not get because resources were allocated to a more pressing short term need, developing manpower supply.

Now, if the research on strikes had continued, if we had had resources for that research, we would have had a much better understanding of strikes and could have continued with that research, despite the fact that there was no practical need for it at that time. These problems occur, particularly with the trends of the business cycle.

Now, if we get a rash of industrial conflicts we come back to this subject again. We start off from where we left off ten or fifteen years ago and we have to start working from there. If the supply of manpower becomes a major problem, then our resources would be diverted there.

So it seems to me that we have so little resources that we have to allocate them to the short term needs rather than having enough financial support to do some very basic research and get a very basic understanding of these problems that recur every ten to fifteen years. Only when we have an understanding of them can we cope with them.

Senator Cameron: But strikes are not new; what has happened to the bank of information?

Dr. Craig: That is what I am saying, they are not new. The bank of information that was obtained was a bank of information only, it was not a bank of analysis, a bank of understanding. Information is data on a whole lot of variables. There was no analytical research in connection with the relationships between these variables.

So this is what we lack today. We have lots of data on strikes, but we have little analysis of that data and the U.S. is in the same situation. If we had carried on with strike analysis through the fifties, rather than devoting all our resources to the manpower field, we

would have a better understanding of strike causation today.

The same thing I think is true of our own Economics and Research Branch in the Department of Labour.

Beginning in the mid-fifties most of our resources went to the development of manpower research—research which eventually helped in the development of manpower policies. There were very little resources devoted to trying to understand industrial relations problems at that time and this, of course, is one of the major reasons why the Task Force on Labour Relations had to conduct an elaborate research program to try and understand some of these fundamental, basic issues, because there was not a solid basis on which to begin.

Senator Cameron: Could you give our Committee any indication as to what resources you think would be necessary to set up a special task force on this analytical problem, analyzing data you already have because this problem has come up in other areas?

Dr. Craig: The Woods task force has had something like seventy or eighty studies conducted for it over a two-year period. I hope the report of this task force will give us a better understanding of many of our problems in the industrial relations field. I do not know if you are aware of the Woods task force that has been set up?

Senator Cameron: I know of Buz Woods' task force.

Dr. Craig: That is right; it has conducted a lot of studies.

Now, granted a lot of these were done over a period of a year, or a year and a half at the most, involving some seventy or eighty people with capabilities varying from the very best to some pretty mediocre. I am not sure whether this task force is going to produce "the answers" or not.

I think what we need to do, and what we will be doing in the department once these reports become public, is to take a close look at them and examine the kind of an understanding we get from them. Where do we have to go from here in terms of research to get a better understanding? What now becomes our research priority, given the understanding that the Woods' task force and its studies give us. This will be one of our major problems in the next year or so, sorting out the priorities, and deciding where we should allocate the few resources we do have.

Mr. Waisglass: If I may add to that, Mr. Senator: You know researchers are, by nature, optimists; they have the fundamental belief that it is necessary for us to keep going in pursuit of the truth, that if we

only had more money for research and more time and resources to devote to research we will ultimately find the answer, and research will solve our social problems.

While I have that feeling I should add some words of caution, that it does not depend entirely on the research. There is a great deal of good research that has already been done; there is a problem of applying it and using it and you do not only need good researchers, you need good managers, people who know how to use research.

The researcher has to know how to bring his research into the areas of innovation, into the problem areas and the managers have to know how to use research.

There is also a problem of too much information; there is too much information and not enough intelligence. If I may say it is a question of knowing how to use research intelligently.

The question for the researcher, which he learns from the beginning, is how to select the data and deal with questions of relevancy.

The managers or the users of research, the decision makers, have to learn the question of relevancy; they have to learn how to use research.

There is a problem of relationship. This is one of the things which I am very much concerned with and which was given a great deal of attention, of bringing research in the dynamic way into the problem solving areas of our society.

While I agree with my colleague, Dr. Craig, that we need more resources and we need more researchers, at the same time researchers have to be concerned with the development of their skills, the application of their research and, in their teaching function, they have a responsibility to help the managers or the decision makers learn how to use research more effectively.

If I may, there is an apt quote in relation to the questions which you raised; I cannot help but bring it in here. It is a recent publication by Harold Wilensky, a sociologist; the title of his book is *Organizational Intelligence*. The sub-title is *Knowledge and Policy in Government and Industry*.

In this particular paragraph—if I may I would like to read here—he says:

Assuming the availability of accurate data and the continued decline in data processing costs, the crucial limitation is not that information technologists are necessarily restricted in intellectual perspectives by the techniques of their job; rather this, that on average their training does not overcome their limited political and social sensitivities. The integration of values, the-

ory and practice nowhere depends more on the supply of talent. The danger of technicism is in direct proportion to the shortage of educated men.

To go on further, later on he says:

That breadth of view combined with technical skill is a prerequisite for technical policy advice. It is especially true when social science is to be incorporated into decision making. In so far as the resources of social research, mainly to make short run predictions, forecasts for the demand for soap, estimates whether internal dissension in Peking will make the Chinese more likely to agree on a bombing escalation or a troop commitment. These kinds of questions, the short term predictions, they deprive themselves of the main contributions of social science. Although there have been many successes in predictions, notably in demography and economics and where the question is simple and the forecast is very short, the specific data of social sciences are typically outdated in the short run. They are far more useful for constructing comprehensive pictures of social reality and for understanding extendable social trends; they are a primary source of political and ideological intelligence.

That, I think, gives a more broad view of this and if I may relate it to some of the problems which I think are general in the use of social sciences in all governments—I am not speaking for my Department or for the federal government. I see this, I think, as a general problem for governments in their use of social sciences, in that the researchers, the social scientists who are employed, are inevitably and probably necessarily concerned in serving the decision makers with the short term and the immediate problems.

As a consequence, the social sciences, because of the priorities that they choose and which perhaps the system imposes on them—I do not say it is deliberate, it is part of the system—do not have the resources to apply to the medium term and the longer term problems where they can really make the most effective contributions.

As a result, when crises come up, crises in public policy formulation, the tendency for all governments, and Mr. Wilensky draws on this; he points out that in the United States that it happened, I am sure it happens in other countries as well; it happens in Canada. The tendency when faced with the problems of a crisis of the need for public policy formulation and you want to draw together a lot of intelligence and research to bear on that problem quickly and immediately and you set up a task force or a Royal Commission, then you find all kinds of research resources become available immediately to that and as soon as that job is finished that organization for research is disbanded, there is nothing.

So that the problem of the deficiencies and the lack of resources for the long term research scientific activities and social science problems, which is necessary for the development of public policy problems which would make a most effective contribution, still remains deficient.

Some time soon some real concerted thought and planning has to be given to the problem of how do you most efficiently and most effectively build up an organization of social science research to deal effectively with these medium term and long term problems?

I think there is a need also, I can see the need and there have been some advocates for establishing, say, a social science research council to do for the social sciences what the National Research Council has done for the physical sciences. There may be a good deal to be said for that; at the same time, however, I think there is a need not to overlook or underestimate the importance of helping that kind of competency in relation to the particular agencies or departments of government who have that responsibility.

If you do not do this, there is always the danger that a department could look at its responsibility in a very narrow and restricted sort of perceptions and its responsibility in terms of administering legislation rather than contributing and looking at their problems in the long term of evolving policies and helping Parliament and Cabinet and their ministers, evolving long range solutions as well as medium range solutions to the problems that can be anticipated. Or should the Department of, say, Health be concerned only with administering the hospital legislation as it is, or should it be concerned with the problems that are much broader than what are given in the terms of the administration of an Act, of developing programs and policies which will enhance the health and well-being of the population?

If you do not have the kind of research capabilities for dealing with and giving the departments or agencies of government the responsibilities for developing public policy on these kinds of public problems, then there is going to be no real point of relevance and no real effective basis for determining priorities for research.

Also, if you have all social science research gathered together in one big establishment, still how do you allocate the resources? That problem still remains and perhaps while there is a need for coordination and for development of total social science activities to enhance it, at the same time we have to have some basis and a market place, say, for these competing needs to be resolved.

Senator Cameron: You need managerial skills to implement the research.

The Chairman: We still have about ten minutes; I would like to ask a couple of questions.

How many researchers did you lose when the Department of Immigration and Manpower was created, do you know?

Dr. George Saunders, Director, Economics and Research Branch, Department of Labour: I think we lost about twenty-five.

Dr. Craig: It was about half and half.

The Chairman: What kind of arrangement do you have with the Department of Manpower in particular in trying to define the borderline between your two research programs?

Dr. Saunders: I think at the moment our relationship is rather informal; we have contacts at the research level with one or two of their officers on particular projects.

For instance, they have a large scale project on defining occupations, which is of interest to us because of our occupational wage rate survey. We are in touch with them on that project.

We have been talking to them from time to time on a study of labour mobility; we do a lot of the wages research in the government service and we are interested in the relationship between wages and labour mobility, the allocation of labour.

Senator Thompson: Could I ask a question here with respect to defining occupations, and this is with the Department of Manpower and Immigration: In defining occupations I presume that you would also look at the qualifications of occupations; is that part of it?

Dr. Saunders: Yes; they are doing work similar to that done on the U.S. *Dictionary of Occupational Titles*, which is fairly elaborate; the U.S. dictionary goes back a number of years now. The Americans have developed it and kept it up to date and Canadian users have been using that dictionary for purposes of defining their own needs in Canada, the Department of Manpower and Immigration has now undertaken a project of developing a Canadian *Dictionary of Occupational Titles* and the research people in the Manpower Department are working on that.

Senator Thompson: My question is really this: This is something I have looked on really with dismay and in fact disgust, and that is the flow of skilled immigrants, professional immigrants to Canada and the history of the waste of talent because of the barriers of unions or professional unions, the lack of information which Dr. Waisglass talked about and said this was a means to get results if intelligently applied.

I do not think the Canadian public know what are the standards overseas, the qualifications in order to be a professional person and how it can be assessed in connection with Canada.

I would ask if ILO have done a comparative study?

The argument on this is that we are protecting the Canadian standards and it is done usually by vested interests, organizations setting the skills and therefore we see doctors and dentists, we are crying for them, and some provinces say they will take them with minimum requirements and other provinces say they cannot, so the protection to the Canadian health situation is rather indefinite.

Are you concerned with that and, if so, what are you doing about it?

Dr. Saunders: We are concerned certainly from the point of view of our responsibilities in the fair employment area.

As a matter of fact, although we have not identified any programs or projects in the area as yet, we have been giving some thought to doing a study on restrictions to entry to the trades and occupations. This matter will be discussed in our May meeting with the provincial research people.

Senator Thompson: Why have you not done something before? You talk throughout here of social justice and the equality of work opportunity; why have you not done anything before? Not from the point of view of you personally.

Dr. Saunders: I am just trying to think back as to whether we did do anything in the days before the split.

Senator Thompson: It sounds like the split between the north and south of Ireland or something.

Dr. Saunders: We did have some studies under the skilled occupational program. I am not too sure whether any of those studies pertained to this particular problem of restrictions to entry; I think it was a matter of priorities and time.

Given the staff . . .

Senator Thompson: You always come back to this, given the staff you would do this. I see this as an extraordinarily exciting department, with a great adventure in making social change, but I think if you get more staff you have got to look at the short term and long term and you have got to be brave and barge out of the concept of responsibility of looking after those who have got collective agreements; there are many other areas of problems that I think you should get into.

Mr. Waisglass: We welcome any kind of encouragement we can get, moral or otherwise.

I should add to what Dr. Saunders has said; our contacts with the research people in manpower have been largely informal. There have also been some formal contacts. We have had some formal discussions with them about our strike statistics and the collecting of common data.

As I pointed out earlier, the Assistant Deputy Minister serves as a member of our Advisory Committee on the grants program; there are a few other instances of formal cooperation.

The Chairman: But do you discuss your research program and do they discuss their research program with you?

Mr. Waisglass: The planning of research programs to some extent, yes, but the overall picture, they do not tell us what they are doing and we do not tell them what we are doing, not because there is any secret.

Usually we are all so doggoned busy minding our own shops that we just have not got the time to mind other people's business.

Dr. Craig: In the research grants program the jurisdictional boundaries are often not very clear. We often get applications for grants under our program which might fall under the Manpower grants program and generally I get in touch with them.

It is not clearly defined, however, there are overlapping areas of jurisdiction.

The Chairman: I am sure I would have other questions, as I am sure the other members of the committee would have too. I do not want to adjourn without thanking you very much and your colleagues for having spent this afternoon with us.

Mr. Waisglass: We appreciate your interest, your kindness and gentleness with us.

The committee adjourned.

APPENDIX 28

CANADA DEPARTMENT OF LABOUR

BRIEF

TO THE

SPECIAL SENATE COMMITTEE

ON

SCIENCE POLICY

January, 1969.

I N T R O D U C T I O N

This brief reports on the scientific activities of the Canada Department of Labour.

There was a change in the Department's responsibilities on January 1, 1966, when the Department of Manpower and Immigration was effectively created and certain functions were transferred to it from the Department of Labour. In the research area the change affected the functions of the Economics and Research Branch insofar as all the research activities and personnel directly associated with the manpower program were transferred to the new Department. Because of the re-organization, this brief reports on the scientific activities of the Economics and Research Branch mainly for the period 1966 to the present.

The basic objective of the Canada Department of Labour is to foster economic and social progress with justice through the promotion of good industrial relations and improved working standards and benefits. In support of this objective, the Department has a Research and Development Program, which is one of the three major areas of the Department's organization. This Program area is responsible for the scientific activities of the Department and is headed by a Director-General who reports to the Deputy Minister.

The basic purpose of the Research and Development Program, which consists of five branches with the major research activities concentrated in two of them, is to improve the quality of public and private decision-making on policy formulation and program administration in the labour field through the provision of optimum research and intelligence functions.

This brief describes the organizational functions and major activities of the Research and Development Program area, and indicates that among the major limiting factors for the conduct of scientific activity are the inadequate supply of highly qualified professionals, and the problems of their recruitment, retention and effective utilization.

1. Organization

a) and b)

1. Attached as Appendix A is an organizational block diagram of the Department, which reports to Parliament through the Minister of Labour. The activities of the Department are structured into three main groupings; labour relations, labour standards and benefits, and research and development. The first two report to the Deputy Minister through Assistant Deputy Ministers and the third reports through a Director-General.

c)

2. The major units responsible for scientific activities are the Economics and Research Branch, the Legislation Branch, the International Labour Affairs Branch, the Special Services Branch and Library Services all of which report to the Director-General of Research and Development. Since most of the research activities are carried out in the Economics and Research and the Legislation Branches, block diagrams of these are attached as part of Appendix A.

3. A number of internal task forces composed of senior officers from both the research and operating branches have been set up to study particular policy issues. For example, one task force recently reviewed the Industrial Relations and Disputes Investigations Act so that

recommendations for amendments could be made in the light of recent research findings and experience in administering the Act.

d)

4. The principal and most important agency outside Canada with which there are formal agreements affecting scientific activities is the International Labour Organization which, under Article 10 of its Constitution, collects and distributes research data on "conditions of industrial life and labour" around the world (copy of Article 10 attached as Appendix B). Canada, as a founding member of the ILO, signified its agreement to uphold the ILO Constitution. Canada has ratified 24 ILO Conventions; of particular relevance to this enquiry is Convention 63 on statistics of wages and hours of work, under the terms of which Canada has agreed to maintain its statistics according to certain criteria.

By virtue of Canada's membership, the Labour Department benefits from, and participates in, the very considerable research program of the ILO in fields of interest to labour.

The Department of Labour participates also in work carried on by the Directorate for Manpower and Social Affairs of the Organization for Economic Cooperation and Development (OECD). This Committee sponsors considerable research to which the Labour Department contributes and from which it benefits as regards policy formulation.

The Labour Department also occasionally sends observers to labour meetings held under the auspices of the Organization of American States.

e)

5. Although the Canada Department of Labour does not have any overseas offices dealing with scientific affairs, there are labour attachés and counsellors stationed in London, Brussels and Washington who keep the Department informed of research activities in other countries. They provide scientific data relevant to our research interests as well as to those of the Department of Manpower and Immigration and other government departments. Our representatives abroad analyse and evaluate data and make comparative studies covering several industries or countries. They also provide information on specific social or economic conditions in Canada at the request of foreign governments and organizations.

2. Organizational Duties

a)

6. The Department's statutory functions and powers regarding scientific activities are contained in a number of statutes including section 10 of the Canada Fair Employment Practices Act, section 12 of the Canada Labour (Safety) Code, section 35 of the Canada Labour (Standards) Code, section 11 of the Female Employees Equal

Pay Act, section 56 of the Industrial Relations and Disputes Investigation Act, and section 4 of the Department of Labour Act.

7. Since this last section is more comprehensive than any other it might be appropriate to quote it:

"With a view to the dissemination of accurate statistical and other information relating to the conditions of labour, the Minister shall collect, digest, and publish in suitable form statistical and other information relating to the conditions of labour, shall institute and conduct inquiries into important industrial questions upon which adequate information may not at present be available, and issue at least once in every month a publication to be known as a Labour Gazette, which shall contain information regarding conditions of the labour market and kindred subjects, and shall be distributed or procurable in accordance with terms and conditions in that behalf prescribed by the Minister".

8. In addition to the statutory functions and powers which support a department's scientific activities, there is an implied responsibility for creative research of an applied nature in order to meet changing technological, economic and social developments. During the 1950s and early 1960s, the Economics and Research Branch, assisted by scientists on contract, conducted a series of studies

which resulted in the development of a positive manpower program. Had it not been for this creative research effort, it is doubtful whether manpower programs in this country would have been developed so propitiously. Some research into the industrial relations aspects of technological change and into collective bargaining was also conducted by the Economics and Research Branch and others under the Department of Labour-University Research Program. This provided a valuable background for the substantial additional research conducted over the past two years in cooperation with and by the Prime Minister's Task Force on Industrial Relations.

b)

9. As implied by the organizational block diagram, the Department has recognized the need for a science policy by establishing a Research and Development Program whose head reports directly to the Deputy Minister.

10. The program's primary purpose is to improve the quality of public and private decision-making on policy formulation and program administration in the labour field by providing the best possible research and intelligence services. The Program's objectives are:

- (i) to improve and apply the knowledge, methods and techniques of the social sciences towards the solution of the social and economic problems of an industrial civilisation;

- (ii) to anticipate and identify emerging problems and to suggest courses of action;
- (iii) to evaluate existing public policies and programs, to explore alternatives, and to predict their consequences;
- (iv) to provide objective, timely and useful data to unions, management, government agencies and the public that would be helpful in decision-making, preventing and resolving industrial conflict and in facilitating organizational innovations and satisfactory human adaptations to change.

11. The aim of the Department's research work is to pursue a scientific approach to the problems in its area of responsibility. This comprises, at the highest level of generality, the use of social science research - including legal research in the development and implementation of the Department's goals and objectives. Over the years the Department has maintained a policy of concentrating its research and scientific activities in the research branches and leaving to them the major responsibilities for the direction of this research. Such a substantial and desirable measure of autonomy has safeguarded an objective and scientific approach and preserved some degree of independence from the more immediate departmental and political concerns.

12. The work of the research area has been important in the development of departmental policies in labour relations, labour standards and benefits, human rights and international labour affairs as well as in the earlier development of manpower programs. The Department fully realizes the importance of objective and scientific analyses of the basic issues in each of the areas where new policies are needed or where existing ones need modification. Such an approach has resulted in the gradual evolution of sound policies based on critical research done both in the Department and elsewhere. This scientific approach - free of prejudices and personal biases - is extremely important and must be maintained in dealing with Canada's highly complex and difficult economic and social issues.

13. The basic objectives of the Research and Development Program are met through the work of the following branches whose objectives are as follows:

Economics and Research Branch - to assist departmental and other government policy makers and administrators, employers, unions, educators and the community in general by conducting research and specialized investigations of industrial relations, personnel problems and the operation of the institutional and market wage systems; by preparing forecasts on socio-economic changes; by providing useful, reliable and

up-to-date statistical and other information; and by serving as a "clearing house" and as a consultative body on research in industrial relations, personnel and other labour matters.

Legislation Branch - to carry out research and to provide information which will assist the development of public policy at both the federal and provincial levels on government intervention in work relationships or conditions of work; to assist in the development of administrative policy for the implementation of federal and provincial labour laws; to further an understanding by the public of labour laws and their purposes and the rights and obligations arising from them; to support outside research by providing basic data.

International Labour Affairs Branch - to strengthen Canadian programs in the labour and social fields by promoting understanding of the work of international organizations and that of other countries, and by the implementation in Canada of international labour standards; to provide information and assistance to other countries and to international agencies; and to provide effective Canadian representation at international meetings.

Library Services - to serve the Department, other departments and agencies, labour management, educational institutions and the general public.

Special Services Branch - to provide effective management support services for departmental program planning, for the implementation of original ideas and research findings, and for experimentation and innovation with special projects, including the Transitional Assistance Benefits program for automotive workers; and any other similar assistance programs that may be enacted for workers who lose their jobs as a result of Kennedy Round tariff changes. The Branch is also responsible for the Emergency Measures Plan as it affects labour conditions, as well as for certain special tasks concerned with the evaluation and coordination of programs and the development of social and economic policies affecting labour.

c)

14. i) The Department also conducts a good deal of research either in conjunction with or for other federal departments and agencies. There are particularly close connections with the Dominion Bureau of Statistics with which a joint study on the cost of fringe benefits is being conducted.

Research and statistics are supplied to the Pay Research Bureau (of the Public Service Staff Relations Board) which provides information to both parties in public service collective bargaining. Similar kinds of data are given to Treasury Board. The Department works with other departments and agencies in the preparation

of forecasts of general economic conditions, which are used also as a basis for decisions on fiscal, monetary and other wide ranging policy measures. This work includes the preparation of statistics used in such forecasting and in the development of analytical techniques for improving their accuracy. Data on the labour market are supplied to and received from other departments. The data received helps the Department of Labour in its wages research and its evaluation of the impact of economic events on industrial relations. The Department cooperated with the Economic Council of Canada in a study of collective bargaining for the Council's Third Annual Review.

Researchers also do a good deal of work for inquiry commissions which may be set up as independent bodies under a number of acts administered by the Department.

15. (ii) The Department's responsibilities to unions and industry are primarily in providing data on wages and working conditions which assist both parties in their collective bargaining and/or personnel administration. This is done mostly through publications on wages, working conditions in industry, collective agreement provisions, monthly wage settlement data, etc., and by responding to numerous letters and telephone inquiries of an ad hoc nature. There is a particular responsibility to provide statistical and research studies for industries under federal jurisdiction. A division has been set up in the

Economics and Research Branch specifically to support such operational personnel as conciliators and mediators who come into direct contact with these industries and their unions. The Department's research officers frequently meet with research representatives from major management and union organizations to determine their needs as precisely as possible.

16. (iii) The Department of Labour-University Research Grants Program provides grants to individual researchers or research groups to assist them in undertaking studies in the labour field. More will be said about this program in a subsequent section.

17. The Department also employs summer students and professors who undertake studies of interest to it and which tie in with the overall scientific activities of the Research and Development Program. Members of the professional staff conduct seminars or give papers to undergraduate and graduate students and departmental publications are made available to professors for use in teaching or research.

18. (iv) As mentioned earlier the labour attachés and counsellors in London, Brussels and Washington are responsible for monitoring of scientific activities in the labour field outside Canada. In addition, the Department arranges for tripartite (government, employer, worker) Canadian representation on numerous ILO, OECD and other

international conferences and seminars which deal with economic and social problems. Briefing is prepared for Canadian government representatives who in turn compile reports on their activities, discussions and decisions at these meetings. These reports include activities and attitudes of other national representatives.

19. Departmental personnel also participate in meetings of such conferences as the annual North American Conference on Labour Statistics and, from time to time, they are loaned to the ILO and the OECD for specific research assignments. Fellowships are granted to academics for research projects at the International Institute for Labour Studies in Geneva, Switzerland. The Department also assists in recruiting Canadian experts for ILO technical aid missions in developing countries and arranges research training programs in Canada for ILO and other trainees.

20. (v) The Department of Labour maintains a close liaison with provincial departments of labour. At the highest official level, this is done through periodic meetings of the deputy ministers and through the Canadian Association of Administrators of Labour Legislation (CAALL) which meets annually. A CAALL statistics and research sub-committee composed of the senior research officers of the federal and provincial departments also meets every year to deal with problems related to labour policy issues. They also have frequent informal contact.

21. The Legislation Branch provides a review of the year's developments for discussion by the CAALL conference. The review surveys current activities in labour standards, labour relations, occupational safety and health, workmen's compensation, and apprenticeship and industrial training so that a comparison and evaluation can be made. The report is published in the Conference Proceedings and becomes a permanent reference document.

d) Program Review

22. Current programs are reviewed and assessed and new programs and projects are proposed during the advance preparation for the Estimates which are now calculated on a five-year basis. Senior officers suggest which programs or projects should be continued or developed and what priority they should have. These suggestions are then examined by the branch directors who submit them to the Director-General of Research and Development who, in consultation with the directors and the users of the Program's services, decides upon a program and priority schedule which will best serve the objectives and responsibilities of the Department. A detailed program is developed for the first of the five years and a general one for the remaining years. This proposed research program then becomes part of the Department's submission to Treasury Board.

Priorities are set again within the limitations imposed by Treasury Board approval and are communicated through the branch directors to senior staff who then attempt to carry out the decisions within the constraints of available resources.

24. This detailed yearly program for each five-year period enables the Department to plan on both a short-term and a long-term basis. But there must always be a degree of flexibility within the detailed one-year program to permit revisions of programs and/or projects as new priorities arise.

25. This description applies with some modifications to the Legislation Branch whose reporting of current developments in the law is a constant commitment. Its priorities must be set for special projects over and above this program and these are dictated by anticipated needs for the development of public policy (frequently the publicly announced intentions of the government).

e)

26. Not applicable

f)

27. The responsibilities of the Department are described in its primary objective which is "to achieve economic and social progress with justice through the promotion of good industrial relations and improved working standards and benefits" and its sub-objectives which are to

- protect the right to organize and to bargain collectively
- settle industrial disputes and encourage cooperation between labour and management
- maintain good standards of wages and working conditions
- achieve equality of job opportunity for all workers
- carry out research for the development of sound labour policies and provide information services to workers, employers and the public
- promote tripartite consultation and the active participation of unions and employers in developing and implementing economic and social policies.

28. To fulfill these responsibilities, the Department has a Conciliation and Arbitration Branch, a Labour-Management Consultation Service, a Fair Employment Practices Branch, a Women's Bureau and other branches (see Appendix A). The Research and Development Program is responsible for providing the research and information for the administration of the programs of these branches and for contributing to the development of new policies and the evaluation of existing policies.

g)

29. The major hindrance to the effective performance of scientific functions and responsibilities (in the Economics and Research and the Legislation Branches) is the inadequate

supply of highly-trained staff. This means that the Economics and Research Branch can only carry out a limited number of searching examinations of the major social issues confronting our industrial society. Yet, more such research is required if sound solutions are to be found and if policy is to be formulated on the basis of an intelligent and sophisticated understanding of these problems.

30. There appear to be three prime reasons for the shortage of qualified persons. The first is that the educational system is not producing social scientists who have the necessary knowledge of the theories and concepts of the recognized social sciences to enable them to undertake, develop and direct policy-oriented research.

31. The second reasons is that the financial rewards are insufficient to attract and maintain an adequate number of these professionals.

32. The third reason is that research in the social sciences does not receive the same substantial monetary support from the public as does research in the physical and medical sciences.

33. The Legislation Branch has tried to overcome its shortage of highly-trained personnel by 'in house' training but, as shown by the turnover of staff in table 2.5 this has not been successful.

34. Major changes in organization function - Some of these changes which we believe to be either probable or desirable in the next five years will be determined more specifically after the Prime Minister's Task Force on Labour Relations has reported and after the Reports of the Royal Commission Inquiry into Labour Disputes in Ontario (The Rank Report) and the Canadian Construction Centennial Inquiry into Industrial Relations in the Construction Industry have been studied.

35. From the research point of view there are, of course, a number of desirable changes. One of the most important is for a greater role in policy-making by social scientists, particularly those who can communicate the results of their research to decision-makers. Equally important is the ability of these decision-makers to communicate their needs and concerns to the scientists. Experiments are underway to discover more effective means of bringing the social scientists into closer work relationships with policy-makers in government and in the private sector.

There is also a need for inter-disciplinary research teams to work more effectively with decision-makers and some action has been taken already in this Department.

36. More attention should be given to research into such problems as worker adjustment to technological change, income distribution, opportunities for the disadvantaged to participate in employment and trade unions, and the rights of the individual in the collectivity.

37. Finally, information systems must be overhauled so that statistical and intelligence services become more useful to the changing needs and requirements of policy-makers and researchers.

3. Personnel Policies

a)

38. The Department uses a number of methods, including the formal Public Service Commission screening process, to recruit effective researchers from university graduating classes. As an informal way for example, senior staff members who give lectures to undergraduate and graduate classes describe the kinds of problems being studied in the Department and the challenge offered by its research work. They also invite members of the class to discuss opportunities in the Department after the lectures.

39. Most of our professional people have close contacts with university faculty members and are able to seek out graduating students who are interested in and capable of research work in the Department of Labour. And, hopefully, the quality of papers written by members of the Department which are used by professors, makes the Department attractive to promising graduates.

40. Finally, the Department of Labour-University Research Grants Program provides assistance to graduate students, primarily to those working towards their doctoral degrees, but in a few cases to MA candidates also. In this way contact is established with many graduate students who are interested in labour matters and, in some cases, the recipients of grants have been attracted to the Department of Labour after their graduate work has been completed.

b)

41. At present, however, there are no unique criteria for identifying creative and effective researchers. An applicant's degree, academic record, school, and the quality of any research work he has done are important criteria. In most cases contact is made either with the applicant's professor or, if he has been employed prior to making application, with his immediate supervisor. In all cases, interviews are held with the applicant.

c)

42. Staff members with high potentiality as research administrators are identified by periodic appraisals by his supervisor who assesses his research and administrative abilities. In addition to these reports, the research capabilities and career development of each research officer are appraised periodically. Many research projects undertaken in the Economics and Research Branch

have elements of research administration and consequently it is possible, by observing the researcher's performance, to determine his potentiality as a research administrator.

d)

43. Regulations of the Public Service Commission govern any distinctions in promotion and salaries of researchers and administrators of research. Generally, research administrators are paid more than research officers. There is no provision in current regulations which allows a researcher as such in a particular area to be paid a salary equivalent to or higher than that of his immediate supervisor. Promotions for researchers are determined largely by their professional skills and capabilities and the changing nature and responsibilities of their duties. Promotions for administrators of research are determined in part by the complexity of the research they administer and by the number of personnel reporting to them, and in part, by their performance and accomplishments.

e)

44. The Department provides for payment of half the cost of courses taken on a part-time basis at local universities by staff members conducting or administering research. It also provides educational leave at half salary for a member of the research staff to obtain a post-graduate degree with the condition that the researcher return to the Branch for a period of time

equivalent to that for which he was supported while at university. Occasionally the Department sends some of its professional personnel on special assignments to international organizations such as the ILO or the OECD, as well as special assignments to royal commissions, task forces, etc.

45. Professional people also get on-the-job training to increase their qualifications. In addition, seminars are conducted in the Branch and may include experts from outside the Department who are invited to participate.

4. Distribution of activities

a)

46. All the intra-mural research activities of the Department are concentrated at headquarters in Ottawa. The following table presents a provincial breakdown of expenditures for extra-mural research under the Department of Labour-University Research Grants Program for the fiscal years 1966-67 to 1968-69. Grants have also been awarded to Canadian graduate students in the United States and the United Kingdom and these are included in the table.

A Regional Breakdown of Grants under the Department of
Labour-University Research Program

	<u>1966-67</u>	<u>1967-68</u>	<u>1968-69</u>
Prince Edward Island.....	-	\$ 2,000	-
Nova Scotia.....	-	-	\$ 3,600
Quebec.....	\$ 28,900	\$25,025	\$15,650
Ontario.....	77,945	62,067	25,400
Manitoba.....	1,000	-	5,000
Saskatchewan.....	2,900	-	-
Alberta.....	8,700	-	2,500
British Columbia.....	-	3,000	7,860
United States.....	15,965	6,200	-
United Kingdom.....	<u>-</u>	<u>500</u>	<u>-</u>
Total.....	\$135,410	\$98,792	\$60,010*

* Expenditures to date.

b)

47. It will be observed from the above table that a very high proportion of expenditures under the Department of Labour-University Research Grants Program goes to the provinces of Quebec and Ontario. This is primarily because of the larger number of universities in these provinces and consequent proportions of applications.

c)

48. The surveys of wages, working conditions, collective agreements, strikes and lockouts and trade union membership are all published with a breakdown by province. Co-operative arrangements also exist with some of the provinces whereby statistics on wages and working conditions collected by the Canada Department of Labour are used by the provinces for further breakdowns: e.g., by industry within the province. Most of the major research projects dealing with wages or industrial relations also provide data and analysis on a regional basis.

49. The development of data and analyses by regions is facilitated by the CAALL Statistics and Research Sub-Committee.

d)

50. Not applicable.

e)

51. Not applicable.

5. Personnel Associated with Scientific Activities

52. The following tables give the information requested on personnel for the Economics and Research Branch and the Legislation Branch.

Table 5 (a) - Current Personnel Establishment and People on Strength by Category of Personnel

Personnel Establishment By Category of Personnel (Revised Estimates 1968-69)							People on Strength by Category of Personnel (November 1, 1968)						
Executive	Scientific and Professional	Administrative and Foreign Service	Technical	Administrative Support	Casuals		Executive	Scientific and Professional	Administrative and Foreign Service	Technical	Administrative Support	Casuals	
2	46	17	13	53	6		2	34	9	11	44	16	

Table 5 (b) - Number of Professional Staff Devoting Most of Their Time to Administrative Duties

If "administrative duties" means personnel and financial administration and not the development and management of research and statistical programs as such, then the answer is "none" in the Economics and Research Branch.

In the Legislation Branch neither in the case of the Director, nor the four division chiefs, is most of their time devoted to administrative duties.

Table 5 (c) - Tabulated Information Regarding Professional Staff
Associated with Scientific Activities
(divided into three categories according to degree level)

I	Country of Birth by Degree Category	Bachelor	Master	Doctorate	Belgium	Canada	England	Estonia	Ethiopia	Guyana	India	Netherlands	Pakistan	Scotland	South Africa	Trinidad	Ukraine	U.S.A.	Austria	Czechoslovakia
I	Country of Birth by Degree Category	Bachelor	Master	Doctorate	21*	5	2	1	1	1	2	1**	1	1	1	1	1		1	
II	Country of Secondary Education by Degree Category	Bachelor	Master	Doctorate	23	5	2		1		1	1	1	1		1				1
III	Country in which University Degree obtained by Degree Category	Bachelor	Master	Doctorate	27	7	1				1						1	2	3	1

* Includes one member with a "Licence en droit" and one with two years in civil law.

** The degree is "Master of the Legal Arts" which entitled the holder to practice law and be admitted to the bar in the Netherlands.

Professionals with

			Bachelor Degree	Master Degree	Doctorate Degree
IV	Number of Working Years since Graduation	Average	11.1	14.8	12.0
		Range	1-39	3-37	5-28
V	Number of Years Employed in Present Organization	Average	6.2	7.1	4.8
		Range	1-36	1-26	1-14
VI	Age	Average	36	40	43
		Range	22-62	26-59	36-58
VII	Percentage able to Operate Effectively in Canada's two Official Languages	Average	39%	25%	-
		Range	11 out of 28	3 out of 12	0 out of 6

Table 5 (d) - Total Number of Professional Staff in Each Degree Category for Each of the Years 1965-66 to 1968-69 Inclusive*

Economics and Research Branch

Degree Category	1965-66	1966-67	1967-68	1968-69
Bachelor	17	24	22	22
Master	4	6	8	9
Doctorate	5	5	6	6
Total	26	35	36	37

Legislation Branch

Degree Category	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
Bachelor	3	3	5**	6**	4	6	6
Master	3	2	2	2	2	3	3
Doctorate	1	1	1	1	1	1	1
Total	7	6	8	9	7	10	10

* The Legislation Branch was not reorganized in 1965-66 when the Department of Manpower and Immigration was created. This permitted to indicate separately the number of professional staff in the Legislation Branch for each of the years 1962-63 to 1968-69. (The reader is referred to the introduction where the reasons for the lack of information for the Economics and Research Branch for the years 1962-63 to 1964-65 are explained).

** One also held LLB

Table 5 (e) Percentage of Staff Turnover in the Three Degree Categories for each of the years 1965-66 to 1967-68*

Economics and Research Branch

Degree Category	1965-66	1966-67	1967-68	1968-69
Bachelor	-	4%	5%	5%
Master	-	33%**	25%	-
Doctorate	-	-	-	25%

Legislation Branch

Degree Category	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
Bachelor	-	-	20%	33 1/3%	25%	16 2/2%	-
Master	33 1/3%	-	-	-	-	-	-
Doctorate	-	-	-	-	-	-	100%

* The percentage of staff turnover for the Economics and Research Branch is for the years 1965-66 to 1968-69 due to the re-organization of the Branch which was effective January 1, 1966 (the percentage of turnover for the first nine months of 1965-66 not being shown in the table for the Economics and Research Branch).

** The high percentage of turnover is due to the small number of professional employees. For example, in 1966-67, 6 professionals in the Economics and Research Branch had a master degree; 2 of them left the Branch during the year, which makes percentage of turnover of 33 per cent.

Table 5 (f) - Percentage of Current Professional Personnel who, since Graduation (ii) have been Employed by Industry at one time, (ii) have been on the Staff of Universities, (iii) provincial departments or agencies, or (iv) other Federal Agencies

	Who have been Employed by Industry	Who have been on the Staff of Universities	Employed by Provincial Departments of Agencies	Employed by Other Federal Agencies
Percentage of Professional Staff (1968-69)	38%	23%	11%	51%

Table 5 (g) - Number of Staff in Each Degree Category on Educational Leave

One part-time in 1967-68 - Economics and Research Branch

One part-time and one full-time in 1968-69 - Economics and Research Branch

Table 5 (h) - Number of University Students Given Summer Employment in the Field of Scientific Activities for the Years 1965-66 to 1967-68

Economics and Research Branch

1965-66	-	5	summer	students	worked	in	the	Branch
1966-67	-	5	"	"	"	"	"	"
1967-68	-	4	"	"	"	"	"	"

6. Expenditures Associated with Scientific Activities

53. The following tables show the total funds spent by the Department on scientific activities. These tables refer to the fiscal years 1966-67, 1967-68 and 1968-69 only. Statements of expenditures for the previous years are not included because, as stated in the introduction to this brief, the organization of the Department was different in the period 1962 to January 1966. It is impossible to provide a breakdown of expenditures by "scientific discipline" and "areas of application".

Table 2.6 (a) - Expenditures on Scientific Activities by Function

	1966-67	1967-68	Forecast 1968-69
Intramural Research and Development	\$843,598	\$ 801,919	\$ 882,885
Collection of Data	-*	318,445	331,638
Scientific Information	32,544	38,116	61,840
<u>Total</u>	<u>876,142</u>	<u>1,158,480</u>	<u>1,276,363</u>
Support of Research and Development in Universities	\$135,410	\$ 98,792	\$ 90,000

* Not available for that year.

Table 2.6 (b) - Expenditures of Units Primarily Concerned with Research

	1966-67	1967-68	Forecast 1968-69
Director General's Office	\$ 36,789	\$ 62,251	\$ 54,619
Economics and Research Branch	668,822	811,080	930,734
Legislation Branch	99,101	103,526	138,841
Library	71,430	81,123	80,094
Data Processing*	n/a	100,500	72,075
Total	\$876,142	\$1,158,480	\$1,276,363

* Although all expenditures for data processing are charged to the Financial and Management Services Branch, the amounts indicated here are estimates of the expenditures associated with the work of the Economics and Research Branch.

54. Included in the above expenditures for the Research and Development Program, the following figures represent the expenditures for extra-mural contract research for the years 1966-67 to 1968-69.

	<u>1966-67</u>	<u>1967-68</u>	<u>1968-69</u>
Contract Expenditures...	\$ 48,447	\$ 98,669	\$ 50,930

c) Funds expended to further professional university education of staff for each of the fiscal years from 1966-67 to 1968-69 inclusive

The following estimated expenditures were made:

1966-67 - \$ 1,000
1967-68 - 2,000
1968-69 - 18,000

7. Research Policies

a) (1)

55. The process whereby various types of programs and projects are initiated and monitored varies. Programs and projects are initiated from an appreciation of actual and potential problems with which government and private decision-makers are or will be confronted. Programs are developed to meet the policy needs of the Department and of the Government and are designed to increase understanding of industrial relations problems and issues, and to provide a basis for the intelligent formulation of policy. Research is also prompted by the needs of the Department's operational programs and to provide important back-up information in depth to conciliation officers. Some research projects have been instituted at the request of outside federal agencies such as the Economic Council, which asked for the co-operation of the Economics and Research Branch in 1965 to study the structure of collective bargaining in Canada. The Prime Minister's Task Force on Labour Relations asked the Research and Development Program Area to undertake a series of studies on collective bargaining, union membership, wage behaviour, and labour law.

56. The Economics and Research Branch has a large labour statistical program which has been in operation for many years. Modifications to this program are made from time to time to meet changing needs and requirements of the users of the information. For example, changes were required in the

statistical program to meet emerging needs of Treasury Board and the Pay Research Bureau for their collective bargaining functions. Similarly, changes have been made to meet the needs of Departmental operational programs.

a) (2)

57. Priorities for programs and projects are determined on the basis of their short-term and long-term contributions to the objectives of the Department. Programs are now established on a five-year basis, but in some detail only for the first year of the five-year program. Within the framework of these long-range plans, a series of projects and programs are identified to meet current or anticipated problems and issues. Because of their ongoing and regular nature, the various statistical surveys, as a rule, undergo only minor changes in their priorities. In the research area, however, there may be major annual changes in programs as projects are completed or as new pressures or anticipated problems which require immediate investigation emerge.

58. These changes and disruptions in a planned research program are to be expected in a government agency devoted to policy research. Experience has shown, however, that in some years programs and projects are carried out very much as they have been planned, whereas in other years their implementation is greatly affected by unanticipated events.

a) (3)

59. Formal methods are currently being implemented to plan and monitor programs and projects. Each year a review of

programs is made for the annual estimates. At this time programs and projects are examined in detail and priorities are established for the coming fiscal year. In this review, decisions are made concerning the efficacy of current projects and programs. New and revised programs and projects are identified and projections are made for the staff and financial resources required.

a) (4)

60. A limited number of projects have been contracted out since 1966 to assist intramural research and statistical programs. These contracts essentially have been of two types:

- (1) Contracts to undertake largely independent studies of major projects in support of departmental research programs.
- (2) Contracts to assist on projects and statistical programs being undertaken within the Department.

Major studies which have been done under contract include work on the employment and working conditions of women, studies of labour legislation and particular industrial relations problems, and the application of data processing to Economics and Research Branch statistics.

The total spent on contract work since 1966 is \$ 198,046 .

a) (5)

61. The funding of extra-mural research programs in the universities is done primarily through the Department of Labour-University Research Grants Program which was started in 1951 and has two major objectives; the development of a body of knowledge in industrial relations, labour economics and other labour matters, and the development of competent researchers in the labour field. Grants are made to university professors, graduate students and others capable of conducting substantial pieces of research. Applicants must be Canadian citizens, have a degree from a Canadian university, or be able to demonstrate that they will be residing in Canada on a continuing basis. Research groups or teams working on a single subject are also eligible to receive grants. Grants have been awarded on the basis of the merits of the applications and the qualifications of the applicants.
62. While intra-mural research programs are designed to implement the objectives of the Department, research grants have not been given solely for this purpose but for a wide range of studies, many of which relate directly to the kinds of programs, problems and policies with which the Department is concerned, while others are more of an "academic" nature and are not closely related to the immediate objectives or policies of the Department. It should be noted here that a substantial number of competent scholars in the labour field in Canada today have at one time or another been supported by grants under this program. The Department is now assessing

this program to decide if it should continue on the same basis as it has in the past, or whether grants should be given only to applicants whose projects lie within the areas of immediate concern to the Department. There is an awareness in the Department also for the need for financial support to develop centres of excellence in interdisciplinary research in industrial relations.

63. Attached to this submission as Appendix C is a list of the awards granted to date and the publications resulting from some of the grants given under the Department of Labour-University Research Grants Program. There are also a substantial number of studies in the Department of Labour Library which have not been published but which are made available to anyone seeking them.

64. The Department of Labour-University Research Grants Program is administered by a committee of senior personnel from the academic community and senior officials of the Departments of Labour and of Manpower and Immigration.

a) (6)

65. Research resources are shifted from a programme to a new programme on an ad hoc basis of higher priority. When possible, use is made of vacant positions - to the extent that any exist - overtime, and the temporary shifting of personnel from one project to another. One of the current difficulties is that new and urgent problems have been arising constantly and because of the scarcity of professional resources, greater resources are allocated to the urgent short-term problems at the expense of the long range research projects.

a) (7)

66. Intra-mural and contracted extra-mural research results are transmitted mostly by departmental and professional journals but some are also presented to formal meetings or conferences. Where appropriate, discussions are held with important users of research: industry, unions, other government departments or agencies at the federal and provincial levels and university professors. Statistics from surveys are transferred through regularly published reports.

a) (8)

67. Practically 100 per cent of the funds available for extra-mural activities were actually expended in the fiscal years of 1966-67 to 1968-69.

a) (9)

68. During these three fiscal years the percentage of funds granted in relation to the amount requested under the Department of Labour-University Research Grants Program has varied from 25 per cent to 40 per cent.

8. Research Output (1965 to 1968)

- 1) Patents arising from research activities Number of licences granted and value of resulting production in Canada and elsewhere.

Not Applicable

- 2) Books or journal articles arising from research activities (1965-68)

The following is a partial list of papers published by professional personnel.

- "Labor" in Encyclopedia Americana. 1968 Revision,
(A. Craig)
- "Collective Bargaining Perspectives", in Industrial Relations, Laval University, November 1968.
(A. Craig and H. Waisglass)
- "Theory and Research in the Field of Industrial Relations" in the British Journal of Industrial Relations, July 1967 (S. Hameed)
- "Wage-Price Process in the Canadian Manufacturing Sector (1949-1963)" in the Journal of Economic Studies, July 1968 (S. Hameed)
- "Development of Labour Unions since Confederation" in Canada 100 (Canada Yearbook 1967) (F.J. McKendy)
- "The CLC looks at itself" in Business Quarterly (spring 1967) (A. Porter)
- "Hours of Work in Canada" in Hours of Work, Industrial Relations Research Association 1965 (Co-author, W.R. Dymond) (G. Saunders)
- "Research Activities of the Economics and Research Branch of the Canada Department of Labour" in Industrial Relations, Laval University, October 1966 (G. Saunders)
- "Collective Bargaining and Inflation" in Industrial Relations, Laval University, November 1968. (G. Saunders)

- "Quebec Labour Code and the Status of Unions and Collective Agreements", Industrial Relations, Laval University, April 1965 - (J.K. Wanczycki).
 - "Union Dues and Political Contributions - Great Britain, United States, Canada - A Comparison", Industrial Relations, Laval University, April 1966. (J.K. Wanczycki).
 - "One Hundred Years of Labour Legislation", Canada 100, (Canada Year Book, 1967) (E. Woolner).
3. Reports issued from agency and units
Economics and Research Branch
- The Behaviour of Canadian Wages and Salaries in the Postwar Period (1967)
 - Changes in the Occupational Composition of the Canadian Force - 1935-1961. (1965)
 - Collective Agreement in Canada - The study of its contents and of its role in a changing industrial environment. (1967) A series of eight papers by Felix Quinet, Chief, Collective Bargaining Division.
 - Forty-two Provisions in Major Collective Agreements Covering Employees in Canadian Manufacturing Industries. (1967)
 - Industrial and Geographic Distribution of Union Membership in Canada. (Annual)
 - Labour Organizations in Canada. (Annual)
 - Payments Systems and Their Development in the Railway Running Trades. (1968) (M. Flood)

- Provisions in Collective Agreements covering Office Employees in Canadian Manufacturing Industry. (1967)
- Provisions in Major Collective Agreements in Canada. (1966)
- Response to Technological Change - A study of technological change provisions contained in major collective agreements effective in Canadian Industries. (1967)
- Strikes and Lockouts in Canada. (Annual)
- Technological Changes in the Railway Industry; Employment Effects and Adjustment Process, CPR Angus Workshops, Montreal. (1967)
- Twenty-five Provisions in Major Collective Agreements Covering Employees in Canadian Industries. (1966)
- Twenty-five Provisions in Major Collective Agreements Covering Employees in Canadian Manufacturing Industries. (1966)
- Wage Rates, Salaries and Hours of Labour. (Annual)
- Wages and Hours in the Primary Textile Industry in Canada. (Annual)
- Working Conditions in Canadian Industry. (Annual)
- Determination of the Appropriate Bargaining Unit by Labour Relations Boards in Canada. Occasional Paper No. 5, Queen's Printer, Ottawa (1967) (E. Herman)
- Wage Determination in Canada; Occasional Paper No. 3, Queen's Printer, Ottawa, April 1965 (G. Saunders)

Legislation Branch

Labour Standards in Canada. (Annual)

International Labour Affairs Branch

The ILO Today. Some observations on its present role and problems. (1967)

4)

69. Departmental officers from time to time give papers or lectures to universities. They also give papers to professional associations and organizations such as the Canadian Political Science Association, the Canadian Industrial Relations Institute, and the Industrial Relations Research Association, to management organizations such as the Canadian Manufacturers Association and Boards of Trade, and to such Government and international groups as the Canadian Association of Administrators of Labour Legislation, the Organization for Economic Co-Operation and Development and the International Labour Organization.

70. In addition, various informal methods are used to transfer the results of research to individuals and agencies outside the Department. These methods include discussions with small groups and with individuals, the distribution of papers on a limited basis, and the provision of information by letter.

71. The following are samples of papers given by members of the Economics and Research Branch to conferences:

- "Wage and Employment Implications of Minimum Wage and Hours Legislation" North American Conference on Labour Statistics, June 1967 (P. Cohen).
- "Minimum Wages and Their Rationale", Statistics and Research Committee, Canadian Association of Administrators of Labour Legislation, May 1968 (P. Cohen).
- "Collective Bargaining Perspectives", 5th Annual Conference of the Canadian Industrial Relations Research Institute, June 1968, (A. Craig and H. Waisglass).
- "Model for the Analysis of Industrial Relations Systems", Annual meeting of the Canadian Political Science Association, June 1967, (A. Craig)
- "The Structure of Collective Bargaining in Canada", Statistics and Research Committee of the Canadian Association of Administrators of Labour Legislation, May 1966 (A. Craig)
- "A Structural-Functional Framework for the Analysis of Industrial Relations Systems", seminar to graduate students and faculty, University of Toronto, November 1967 (A. Craig)
- "On Cyclical Fluctuations in Seasonal Components of Economic Time Series", Canadian Political Science Association conference on statistics, 1967 (D. Fairbairns)
- "Current Price Situation", North American Conference on Labour Statistics, 1968 (D. Fairbairns)

- "Small Establishment Surveys" Statistics and Research Committee of the Canadian Association of Administrators of Labour Legislation. 1967 (R. Gaudreau)
- "Wages and Working Conditions Surveys in the Textile Industry" Industrial Relations Conference, Canadian Textiles Institute. 1965 (R. Gaudreau)
- "Collection of Wages and Related Data - U.S. and Canada", North American Conference on Labor Statistics. Toronto 1967, (R. Gaudreau)
- "Concepts and Problems in Dealing with Statistics of Strikes and Lockouts", Statistics and Research Committee of the Canadian Association of Administrators of Labour Legislation, 1967, (F.J. McKendy)
- "Professionals and Collective Bargaining", Annual Meeting of the Statistics and Research Committee, Canadian Association of Administrators of Labour Legislation, 1967, (F.J. McKendy)
- "Labour Organizations Current State of Statistics", Annual Meeting of the Research and Statistics Committee of the Canadian Association of Administrators of Labour Legislation, 1967, (F.J. McKendy)
- "Concepts for Measuring Fringe Benefits", Canadian Political Science Association Statistics Conference, 1962 (J. Millons)

- "Wage Parity", Forum held at Loyola College and Guelph University, 1967, (A. Porter)
- "Trends in Wages", Canadian Pharmaceutical Association, 1967 (A. Porter)
- "Wage Research", Department of Manpower and Immigration Training Sessions - 1967 (A. Porter)
- "Wage Behaviour, Inflation and Labour Mobility", Seminar at Carleton University, 1969 (A. Porter)
- "Collective Agreement Provisions Regarding Technological Changes" 33rd Convention of the French Canadian Association for the Advancement of Sciences, November 1965 (F. Quinet)
- "The Need for Analyzing Collective Agreements in Canada", Industrial Relations Research Association, Montreal, January 1967 (F. Quinet)
- "Technical Innovations and Collective Bargaining", Faculty members and students, Department of Business Administration, Laurentian University, March 1967 (F. Quinet).
- "The Economics of Privately Negotiated Technological Change Provisions" prepared for the Industrial Relations Research Association, Twentieth Annual Meeting, 1967 (D. Ross).
- "Trade Unions, Collective Bargaining and Inflation", 13th Annual Congress of Quebec Commerce Students, 1965 (G. Saunders.)

- "Wages and Labour Mobility", Seminar to Graduate Students and Faculty Members, University of Toronto, 1966 (G. Saunders).
- "Technological Change and Security of Employment", Conference on Law and Industrial Relations, University of Toronto, May 1966 (G. Saunders).
- "Economic and Technological Change in the Sixties: Implications for training, manpower adjustments and mobility, for labour management relations, labour relations and related legislation, policies and programs", British Columbia Labour Management Conference on Industrial Relations, May 1965 (G. Schonning).
- "The Impacts of Economic and Technological Change on Various Aspects of Employment and Manpower", Second National Seminar on Guidance and Counselling, Niagara Falls, Ontario, October 1965 (G. Schonning).
- "Research and Statistical Needs for an Active Industrial Relations Policy", CAALL Statistics and Research Committee, May 1967 (G. Schonning).
- "The Challenge for Statisticians in our Age of Rising Expectations", North American Conference on Labor Statistics, 1968 (H. Waisglass).

The following paper was given by the Director of the International Labour Affairs Branch:

"Canada as an ILO member: Performance and Potential",
International Affairs Seminar, Canadian Labour
Congress, October 1968 (J. Mainwaring)

- 5) Not applicable.
 - 6) The following individuals who have had the opportunity to train themselves in specialized fields whilst employed by the Department have subsequently left and made important contributions to their field.
72. - Robert M. Adams, Director, Compensation Policy, Treasury Board.
- Imré Bernolak, Chief, Productivity Analysis Division, Department of Industry.
 - Cal Best, Director of Personnel, Comptroller of the Treasury.
 - Boris Celovsky, Director of Programs and Policy, Department of Manpower and Immigration.
 - F.J. Doucet, Economist, The Atlantic Development Board.
 - W. Duffet, Dominion Statistician.
 - W.R. Dymond, Assistant Deputy Minister, Department of Manpower and Immigration.
 - J.P. Francis, Assistant Deputy Minister, Department of Manpower and Immigration.
 - Doris French, Free Lance author.
 - Stanley Goodman, Director, Manpower Information and Analysis Branch, Department of Manpower and Immigration.
 - C. Harper, Director of Staff Relations, Post Office Department.

- D.G. Hartle, Professor of Economics and Director, Institute of Quantitative Studies, University of Toronto.
- G.V. Haythorne, Special Adviser, Income and Prices Board.
- J.D. Love, Deputy Minister, Canada Department of Labour.
- John McDonald, Professor, Trent University.
- John Mainwaring, Director, International Labour Affairs Branch, Canada Department of Labour.
- Noah M. Meltz, Professor of Economics, University of Toronto.
- J.T. Montague, Professor of Economics and Director of the Institute of Industrial Relations, University of British Columbia.
- Mrs. S. Ostry, Director, Special Manpower Studies and Consultation, Dominion Bureau of Statistics.
- Roy Reynolds, Kaiser Industries, United States.
- Dalton Robertson, Financial Post.
- Gil Schonning, Labour Counsellor, London, England.
- Merrick Spalding, Research Branch, Department of Manpower and Immigration.
- H.J. Waisglass, Director General, Research and Development, Canada Department of Labour.

7) Research Terms

Not applicable.

8)

73. Some of the unique or valuable research tools which have been developed are listed below. Descriptions are given in Appendix D.

a) A large expansion in the "information system" in the area of collective agreement analysis is now being developed. This will be based on a comprehensive scheme for coding the contents of collective agreements and will be operated by computer. When developed, it will enormously increase the amount of data accessible to researchers and other users. (See Appendix D)

b) A framework for the analysis of industrial relations systems has been developed which permits a more comprehensive, integrated and systematic approach to the study of industrial relations than has hitherto been possible. A paper describing this framework is attached as Appendix D.

c) A method has been developed to analyse the impact of wage trends on Canada's international trade, by studying the relationship of wages, productivity, costs of production and prices in import-competing, export-competing and domestic industries. See Appendix D for a study describing this method.

d) A technique for measuring wage change has been developed and used to compute the Department of Labour's annual wage rate index. (See Appendix D)

e) Methods of collecting, tabulating and presenting data, including applying advanced computer techniques to these processes have been improved to make Department of Labour statistics more useful and timely to public and private decision makers and to research workers in the social sciences.

9)

74. The framework for the analysis of industrial relations systems (See D) was used by the Prime Minister's Task Force on Labour Relations in organizing its research program. It was also used by a number of researchers who conducted studies for the Task Force and it is being used by many professors in their graduate and undergraduate classes in labour economics.

75. The system for coding the contents of collective agreements developed in the Economics and Research Branch has been a basis for developing similar systems by provincial government agencies and private organizations, and by foreign governments and international agencies.

76. The studies produced in the Department (including statistical materials) increase the knowledge of industrial relations and the operation of the labour market on a national, regional and industrial basis. They also provide a basis for further scientific work.

77. Research and statistical information has been useful in the settlement of industrial disputes and the development of labour standards. The Department's intelligence service is used widely by federal and provincial government agencies in economic planning and by decision-makers in the private sector.

9. Projects

1)

78. The following studies are part of the general economic analysis program of the Economics and Research Branch which, in its research and development aspects, is designed to fill gaps and eliminate weaknesses in the system of preparing analysis of general economic conditions used interdepartmentally. Much of the output consists of minor innovations in methods. However, there are three areas in which a good deal of activity has been carried out since 1966:

- Decomposition of economic time series having seasonal components showing short-term amplitude variation
- preparation and use of an integrated framework for analysis of wage-price relationships
- development of statistics based on information relating to wage settlements.

79. Studies in the statistical development program of the Branch are designed to develop current statistics in certain aspects of the labour market and the labour force.

- Surveys and analyses of labour organizations, studies of structure of union membership - (annual projects).
- Collection, analyses and publication of information on strikes and lockouts in Canada, on a monthly and annual basis.
- Special analyses in above fields, for example, commencement of a study on historical trends in union membership (1967).
- Surveys and analyses of the content of collective agreements (annual project).
- Coding manual for analysis of collective agreements.
- Survey of wage rates (annual)
- Survey of working conditions (annual)
- Survey of industrial accidents (annual)
- Special surveys: for example, survey of the textile industry, and the joint survey with DBS on labour costs.

80. The studies listed below constitute projects in the policy research area and are designed to examine in depth the problems and issues of major concern to the Department.

- Analysis of provisions in collective agreements arising out of technical and industrial change.
- Study of the structure of collective bargaining in Canada.
- Wage determination in Canada.
- Study on the relations between wages and costs of production.

- Canadian wage behaviour in the postwar period.
- The study of Labour Costs in 25 Canadian Industries.
- Wages in Canada and the United States, a comparison.
- Study of collective bargaining in the pulp and paper industry.
- Study of collective bargaining in the iron and steel industry.
- Study of strikes in the postwar period.

81. The following studies are conducted in the Branch's program research area. The operational research program is concerned with providing research data in support of the operations of other Branches in the Department. The two main areas to which this program has contributed are Labour Standards and Industrial Relations.

- Hours of work studies - shipping, trucking, railway running trades industries.
- Study of vacation and overtime provisions in the longshoring industry.
- A study of the economic effects of the Canada Labour (Standards) Code on employment, wage structure and working conditions.
- Development of a statistical program, in co-operation with Treasury Board, for the collection and analysis of accident data within the Federal Public Service.

- Development of criteria to enable the shipping industry to conform with the maximum hours of work of the Labour Code.
- Comprehensive fact books to provide basic data for conciliation and mediation purposes have been prepared for the following industries: longshoring, railways and airlines. Other fact books are in the process of development.
- An in-depth study of the industrial relations system in the longshoring industry.

2)

82. The following is a sample of significant completed projects undertaken since 1965 in the Economics and Research Branch.

a) Canadian Wage Behaviour in the Postwar Period. This study was published in June 1967 as a chart book which portrays Canadian labour income, both wages and salaries. Some of the charts portray the structure of wages and salaries in 1965 (the most recent year for which complete data were available, except for a few charts containing 1966 information). The absolute values are shown for various classifications of industries, regions and occupations. The relation of wages and salaries among these groups is expressed in index form or as percentage deviations from some general average. It is these relations that constitute a wage structure.

83. The approach has been first to portray the 1965 situation, followed usually by charts depicting the trend over the years, mostly since 1949. As would be expected, labour earnings have increased more rapidly in some industries, regions and occupations than in others. Relative rates of growth are illustrated in some charts making it easy to identify the "pacers" and laggards. The extent to which the gap between the earnings of certain occupations has widened or narrowed is illustrated.

84. Other aspects of wage behaviour are also illustrated. These include a comparison of the labour share of net domestic product with the shares going to investors and unincorporated business, a comparison of trends in money wages and real wages (that is, money wages discontinued for rising consumer prices), a comparison of hourly wage trends in manufacturing with trends in production and manhour productivity. Finally, but certainly not last in importance, the pattern of major collectively bargained wage settlements is presented.

b) Hours of Work in Canada. - This is a study showing hours of work patterns in Canada and some of the economic factors explaining these patterns. One article on this study was published: W.R. Dymond and George Saunders, "Hours of Work in Canada" in Industrial Relation Research Association Publication No. 32A, Hours of Work, editors Clyde E. Dankert, Floyd C. Mann and Herbert R. Northrup.

c) Wages in Canada and the United States: An Analytical Comparison.

85. In view of the considerable attention being given to the demands of some Canadians for parity of wages with the United States, the moves towards greater freedom of trade between the two countries, and the great influence of U.S. industrial relations on Canadian trends in this area, it is especially important at this time to devote greater attention to the Canadian and United States labour forces and labour markets and the operation of the wage and industrial relations systems in both countries.

86. The study is primarily descriptive although there is some analysis in that some of the comparisons have been made in detail. However, it does not explain wage behaviour nor does it attempt to assess the influence of the many market and 'institutional' forces that can be expected to affect such behaviour. Two parts of the study which will be completed later will move a little way towards explanation by examining and comparing the responsiveness of wages to changing conditions in both countries and by considering the possibility that some of the differences in Canadian and United States wages may be the result of differences in the quality of available labour.

d) A Model for the Analysis of Industrial Relations Systems

87. In recent years the emerging discipline of industrial relations has been undergoing an 'agonizing appraisal' both in terms of its subject matter and the methodology employed in its research. While studies in other social science disciplines such as economics, political science, and sociology have produced useful analytical research models and significant theoretical achievements, studies in industrial relations have been confined, with a few notable exceptions, to descriptive case studies, descriptive history, descriptions of collective agreement provisions, and formal analysis of statutory and common law developments. Where attempts have been made at some degree of generalization these have been at the level of partial theory only. Unfortunately, the partial theories that have been developed have not yet been sufficiently integrated to provide even a minimum understanding of the totality of industrial relations behaviour.

88. The purpose of this study was to articulate, however, briefly, a conceptual model which, hopefully, would be useful for conducting analytical studies and, eventually, for unifying the various partial theories into a general theory of industrial relations. The model presented drew heavily on the works of a number of writers in various social science disciplines and brought together a sufficient core of concepts for analyzing the totality of industrial relations behaviour.

89. e) A Study of Wages and Labour Mobility in Canadian Industry was undertaken for the OECD as part of a series of studies for purposes of assessing the efficacy of an incomes policy for a number of western countries. The study examines wage trends by industry, region and city, and relates these trends to changes in employment and labour turnover. A number of economic variables such as productivity, output, prices and degree of competition are introduced into the analysis to explain their relationship to wage behaviour.

90. f) Studies of the Impact of Technological Change. Two recently completed studies in this program of studies show the extent to which labour management are responding to the adverse impact of technological change, and analyse the economic impact of technological change provisions showing their effect on costs at the local, regional, and national levels.

91. g) A Study of Collective Bargaining in the Construction Industry was recently completed for the Canadian Construction Association Centennial Inquiry on Labour Relations. The study describes the range of provisions characteristic of construction industry collective agreements and analyses changes in the incidence of provisions since the mid-1950's.

92. h) Hours of Work Study for the Shipping Industry. In the field of labour standards, this study had a major impact in influencing the hours of work patterns eventually adopted by the industry in complying with the Labour Code.

The developmental work associated with this study set the pattern for dealing with similar problems in other federal industries operating on a continuous basis.

93. i) System of Coding Collective Agreements. This is a project which was initiated in 1967. The objective was to code the provisions of existing collective agreements in Canada. The first stage was resulted in the completion of a coding manual which will help the Branch's technical personnel to code between 80% and 90% of the provisions of any collective agreement. In order to code as many agreements as possible, work is now under way to include in the Branch files all collective agreements concluded in Canada.

94. j) A series of statistical surveys is undertaken and completed each year giving current data on occupational wage rates and working conditions by industry and area, trade union membership by union, industry and area, work stoppages by major establishments, industry and area, and wage trends in large negotiating units.

APPENDIX A

ORGANIZATIONAL CHARTS

- DEPARTMENT OF LABOUR
- ECONOMICS AND RESEARCH BRANCH
- LEGISLATION BRANCH


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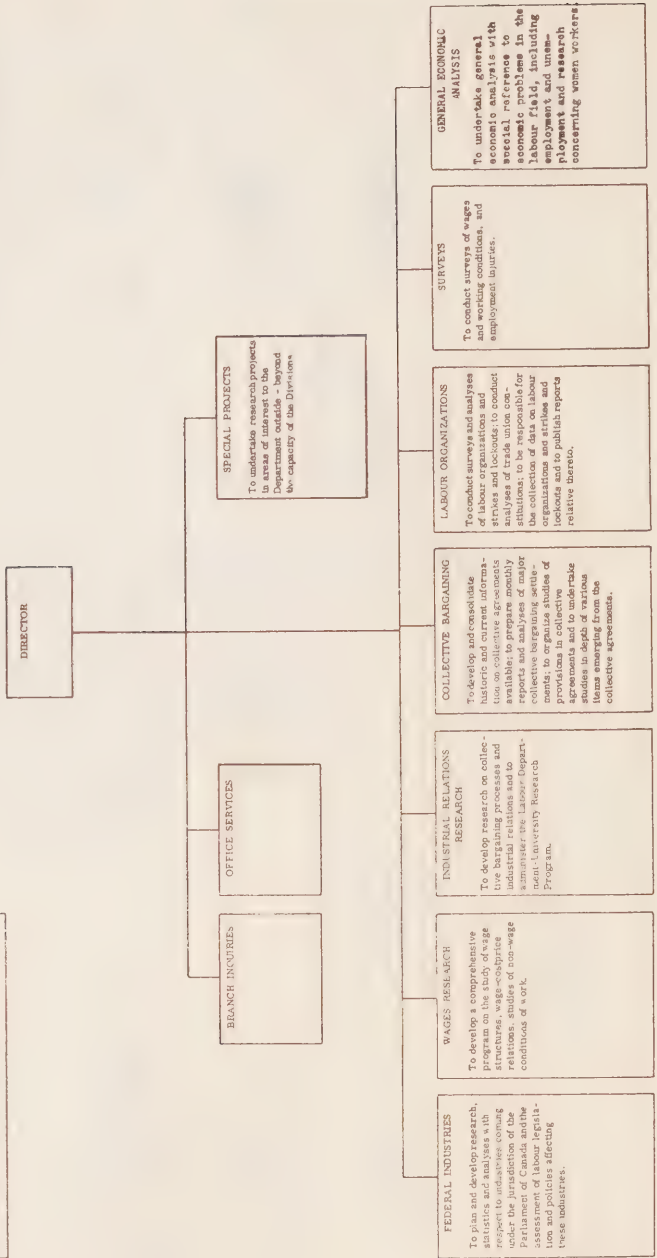
graph TD
    ML[MINISTER OF LABOUR] --- PSL[PARLIAMENTARY SECRETARY TO THE MINISTER]
    ML --- CBL[CANADA LABOUR RELATIONS BOARD]
    ML --- MSCB[MERCHANT SEAMEN COMPENSATION BOARD]
    ML --- DM[DEPUTY MINISTER]
    DM --- LRS[LEGAL SERVICES  
(Seconded from Justice)]
    DM --- FMS[FINANCIAL AND MANAGEMENT SERVICES]
    DM --- PRA[PERSONNEL ADMINISTRATION]
    DM --- PRIS[PUBLIC RELATIONS AND INFORMATION SERVICES]
    DM --- DGRD[DIRECTOR GENERAL RESEARCH AND DEVELOPMENT]
    DM --- AMR[ASSISTANT DEPUTY MINISTER LABOUR RELATIONS]
    DM --- ADM[ASSISTANT DEPUTY MINISTER LABOUR STANDARDS AND BENEFITS]
    DGRD --- ER[ECONOMICS AND RESEARCH]
    DGRD --- ILA[INTERNATIONAL LABOUR AFFAIRS]
    DGRD --- LEG[LEGISLATION]
    DGRD --- SS[SPECIAL SERVICES]
    DGRD --- LIB[LIBRARY SERVICES]
    AMR --- CAR[CONCILIATION AND ARBITRATION]
    AMR --- LMC[LABOUR MANAGEMENT CONSULTATION]
    AMR --- ERP[EMPLOYEE REPRESENTATION]
    AMR --- FEP[FAIR EMPLOYMENT PRACTICES]
    ADM --- LST[LABOUR STANDARDS]
    ADM --- IPA[INDUSTRIAL PENSIONS AND ANNUITIES]
    ADM --- WBI[WOMEN'S BUREAU]
    ADM --- APC[ACCIDENT PREVENTION AND COMPENSATION]
  
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Total Positions, Department 849(26)
APRIL, 1968.

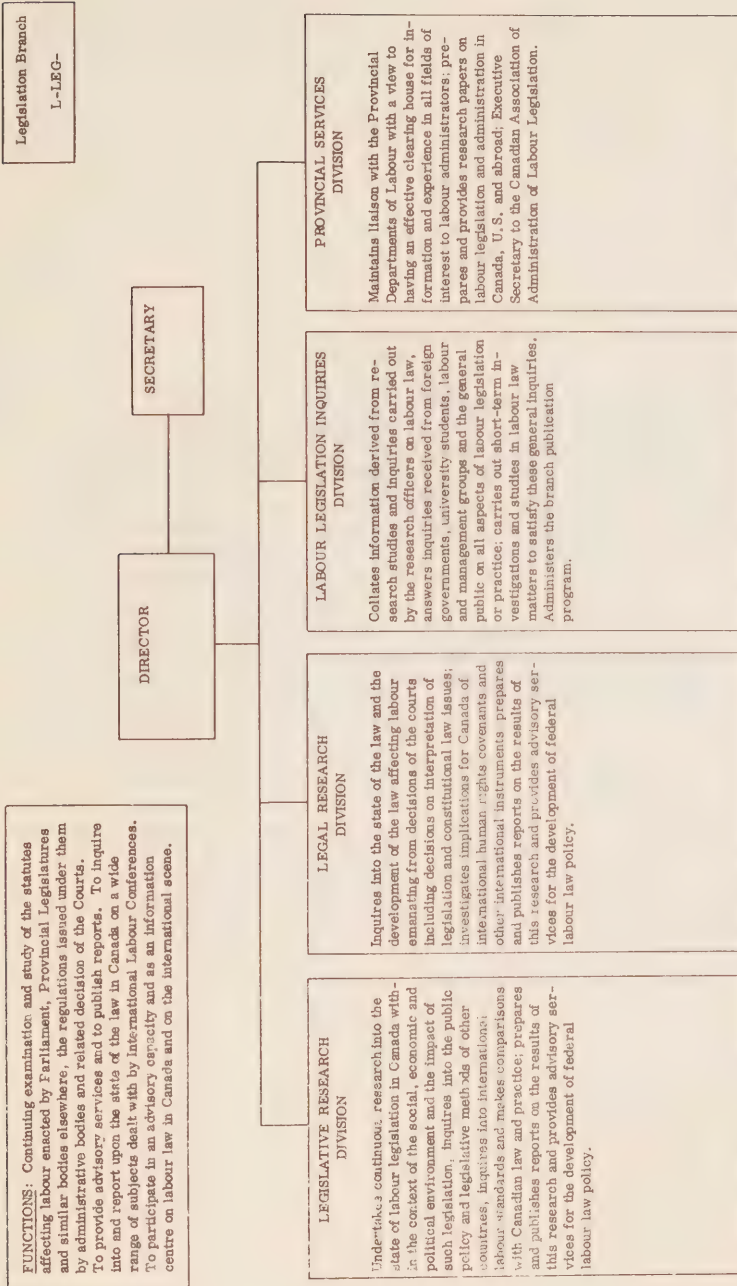
RESEARCH AND DEVELOPMENT

FUNCTIONS. To undertake basic surveys, analyses and research in Wages Research, Federal Industries, General Economic Advisers, Industrial Relations, Collective Bargaining, Labour Organization, and Social Factors, and to coordinate and administer the economic and social factors determining them.

Economics and Research Branch
L-5R-



RESEARCH AND DEVELOPMENT



Total Positions - 17

APRIL, 1968

() Indicates proposed classification.
* Unclassified

APPENDIX B

I.L.O. CONSTITUTION
ARTICLE 10

INTERNATIONAL LABOUR ORGANIZATION

Construction
Art. 10Functions of
the Office

Article 10

1. The functions of the International Labour Office shall include the collection and distribution of information on all subjects relating to the international adjustment of conditions of industrial life and labour, and particularly the examination of subjects which it is proposed to bring before the Conference with a view to the conclusion of international Conventions, and the conduct of such special investigations as may be ordered by the Conference or by the Governing Body.

2. Subject to such directions as the Governing Body may give, the Office shall--

- (a) prepare the documents on the various items of the agenda for the meetings of the Conference;
- (b) accord to governments at their request all appropriate assistance within its power in connection with the framing of laws and regulations on the basis of the decisions of the Conference and the improvement of administrative practices and systems of inspection;
- (c) carry out the duties required of it by the provisions of this Constitution in connection with the effective observance of Conventions;
- (d) edit and issue, in such languages as the Governing Body may think desirable, publications dealing with problems of industry and employment of international interest.

3. Generally, it shall have such other powers and duties as may be assigned to it by the Conference or by the Governing Body.

APPENDIX C

AWARDS GRANTED FISCAL YEARS - 1952-1969
DEPARTMENT OF LABOUR-UNIVERSITY RESEARCH PROGRAM

AWARDS GRANTED FISCAL YEARS - 1952-1969DEPARTMENT OF LABOUR-UNIVERSITY RESEARCH PROGRAM

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
<u>1951-1952</u>		
ARMSTRONG, D., McGill University, Montreal (Quebec)	"Examination of Collective Bargaining in the Coal Industry in Alberta"*	\$ 1,100.00
MARTIN, S., University of Toronto, Toronto, Ontario.	"Canadian Conciliation and Arbitration Legislation"	1,300.00
		Total \$ 2,400.00
<u>1952-1953</u>		
ARMSTRONG, D., McGill University, Montreal (Quebec)	"Examination of Collective Bargaining in the Coal Industry in Alberta"*	\$ 700.00
CURTIS, C.H., Queen's University, Kingston, Ontario.	"Rules of Procedure and Practices in Arbitrations under Agreements in Ontario"*	1,050.00
LOGAN, H.A., University of Toronto, Toronto, Ontario.	"The Effect of Third Party Intervention on the Process of Bargaining"*	1,000.00
MARTIN, S., University of Toronto, Toronto, Ontario.	"Canadian Conciliation & Arbitration Legislation"	800.00
OLIVER, Michael, McGill University, Montreal (Quebec)	"Third Party Intervention in the Quebec Textiles Industry"*	1,400.00
TOUSIGNANT, Miss R., Laval University, Quebec (Quebec)	"Arbitration Under the Public Service Employees Dispute Act of Quebec"	850.00
VASELENAK, J.R., University of B.C., Vancouver, B.C.	"Labour Dispute Settlement in the Logging and Pulp and Paper Industries in British Columbia"*	1,500.00
		Total \$ 7,300.00
<u>1953-1954</u>		
BRECHER, M., McGill University, Montreal (Quebec)	"Men's Garment Industry: Patterns of Accommodation in the Quebec Men's Garment Industry"*	\$ 1,000.00

* Published, see Appendix attached.

Special Committee

<u>Name and University Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
<u>1953-1954</u>		
CARROTHERS, A., University of British Columbia, Vancouver, British Columbia.	"The Labour Injunction in B.C., 1946-1955"*	\$ 900.00
CURTIS, C.H., Queen's University, Kingston, Ontario.	"Rules of Procedure and Practices in Arbitrations under Agreements in Ontario"*	\$ 200.00
HENDRY, J.M., Dalhousie University, Halifax, Nova Scotia.	"The Settlement of Industrial Disputes in the Major Industries of Nova Scotia"	\$ 800.00
JAMIESON, Stuart, University of British Columbia, Vancouver, British Columbia.	"Settlement of Building Trades Disputes in B.C."*	\$ 1,000.00
PRATT, R.C. and FRANKEL, S.J., McGill University, Montreal (Quebec).	"The Relations between Municipalities and Employee Organizations in Canada"*	\$ 800.00
VASELENAK, J.R., University of British Columbia, Vancouver, British Columbia.	"Labour Dispute Settlement in the Logging and Pulp and Paper Industries in B.C."*	\$ 300.0
WOODS, H.S., McGill University, Montreal (Quebec).	"Editing Composite Volume"*	\$ 500.00
	Total	\$ 5,500.00
<u>1954-1955</u>		
BEAUSOLEIL, Gilles, McGill University, Montreal (Quebec).	"Conciliation Boards in the Province of Quebec"	\$ 1,250.00
CARROTHERS, A., University of British Columbia, Vancouver, British Columbia.	"The Labour Injunction in B.C., 1946-55"*	\$ 300.00

* Published, see Appendix attached

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
<u>1954-1955</u>		
EASTMAN, Sheila B., University of Toronto, Toronto, Ontario.	"Settlement of Labour-Management Disputes in the Ontario Textiles Industry with Attention to Technolo- gical Change and Productivity"	\$ 1,200.00
LOGAN, H.A., University of Toronto, Toronto, Ontario.	"The Effect of Third Party Intervention on the Process of Bargaining"*	\$ 250.00
PORTER, A.A., University of Toronto, Toronto, Ontario.	"Analysis of Conciliation Techniques in the Province of Ontario as a Means of Settling Industrial Disputes"	\$ 1,000.00
WOODS, H.D., McGill University, Montreal (Quebec).	"Editing Composite Volume"*	\$ 500.00
Total		\$ 4,500.00
<u>1955-1956</u>		
EASTMAN, Sheila B., University of Toronto, Toronto, Ontario.	"Industrial Relations Policies of Employers and Unions in the Ontario Agricultural Implement Industry"	\$ 1,200.00
LOGAN, H.A., University of Toronto, Toronto, Ontario.	"The Effect of Third-Party Interven- tion on the Process of Bargaining".*	\$ 250.00
OSTRY, Mrs. S., McGill University, Montreal (Quebec).	"Disputes Settlement in the Railway Industry"	\$ 750.00
PHILLIPS, W.G., Assumption University, Windsor, Ontario.	"Conciliation Procedures as seen in the Ford and Chrysler Negotiations of 1954-55"*	\$ 600.00
WRONG, E.G., University of Toronto, Toronto, Ontario.	"A Determination of the Relationship Between Socio-economic Background, Experience and Training and the Success Achieved by Conciliators and Arbitrators in Settling Labour-Management Disputes"	\$ 1,200.00
Total		\$ 4,000.00
<u>1956-1957</u>		
BEAUSOLEIL, Gilles, McGill University, Montreal (Quebec).	"Conciliation Boards in the Province of Quebec"	\$ 1,000.00

* Published, see Appendix attached

Special Committee

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
<u>1956-1957</u>		
F VCHARD, Maurice, University of Montreal, Montreal (Quebec).	"Economic Interpretation of Collective Agreements"*	\$ 1,200.00
CARROTHERS, A., University of British Columbia, Vancouver, British Columbia.	"A Comparison & Critical Annotation of Canadian Collective Bargaining Statutes"*	\$ 1,500.00
FRANKEL, Saul J., (See PRATT, R.C.), McGill University, Montreal (Quebec).	"Employer-Employee Relations in the Canadian Federal Civil Service"*	\$ 1,200.00
LAND, Brian, University of Toronto, Toronto, Ontario.	"The Labour Gazette as a Source for Studies in Industrial Relations and Other Labour Matters"	\$ 800.00
WRONG, E.G., University of Toronto, Toronto, Ontario.	"A Determination of the Relationship Between Socio-economic Background, Experience and Training and the Success Achieved by Conciliators and Arbitrators in Settling Labour-Management Disputes"	\$ 500.00
Total		\$ 6,200.00
<u>1957-1958</u>		
ANTON, F.R., University of Alberta, Edmonton, Alberta.	"Government Supervised Strike Votes"*	\$ 1,000.00
FRANKEL, Saul J., (See PRATT, R.C.), McGill University, Montreal (Quebec)	"Employer-Employee Relations in the Canadian Federal Civil Service"*	\$ 800.00
HEBERT, Gerard, McGill University, Montreal (Quebec)	"Juridical Extension of Collective Agreements in the Quebec Building, Industry"*	\$ 1,200.00
KRUGER, A.M., University of Toronto, Toronto, Ontario.	"Labour Relations in the Canadian Basic Steel Industry"	\$ 2,200.00
LAND, Brian, University of Toronto, Toronto, Ontario.	"The Labour Gazette as a Source for Studies in Industrial Relations and Other Labour Matters"	\$ 500.00

* Published, see Appendix attached

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
<u>1957-1958</u>		
WILKINS, W.G., Assumption University, Windsor, Ontario.	"Expansion and Continuation of Study of Conciliation in the Automobile Industry"*	\$ 1,000.00
	Total	\$ 6,700.00
<u>1958-1959</u>		
ANTON, F.R., University of Alberta, Edmonton, Alberta.	"Government Supervised Strike Votes"*	\$ 1,000.00
DAVIES, R.K., University of British Columbia, Vancouver, British Columbia.	"Arbitration in the Settlement of Disputes" (negotiations and arbitration of disputes between teachers' organizations and school Boards in B.C.)	\$ 1,200.00
DIETRICH, J.S., University of British, Columbia, Vancouver, British Columbia.	"Labour Arbitration in B.C."	\$ 1,000.00
KRUGER, A.M., University of Toronto, Toronto, Ontario.	"Labour Relations in the Canadian Basic Steel Industry"	\$ 200.00
MEHLING, Jean, University of Ottawa, Ottawa, Ontario.	"Labour Management Relations in the Metal Mining Industries of the Province of Quebec"*	\$ 1,200.00
WILLIAMS, T.D., McGill University, Montreal (Quebec).	"Technological & Union Management Relations: dieselization of Canadian railways"	\$ 1,000.00
WOODS, H.D., McGill University, Montreal, (Quebec).	"Major Issues in Union Management Relations"*	\$ 400.00
	Total	\$ 6,000.00
<u>1959-1960</u>		
ANTON, F.R., University of Alberta, Edmonton, Alberta.	"Government Supervised Strike Votes"*	\$ 500.00
BROMKE, A., McGill University, Montreal (Quebec)	"The Labour Relations Board in Ontario as an Administrative Tribunal"*	\$ 1,200.00

* Published, see Appendix attached

Special Committee

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
CARDIN, Réal, University of Montreal, Montreal (Quebec)	"The Quebec Collective Agreements Extension Act"	\$ 1,200.00
CRISPO, J.H.G., University of Toronto, Toronto, Ontario.	"Labour Management Relations in the Ontario Hydro-Electric Power Commission"	\$ 1,200.00
DIETRICH, J.S., University of British Columbia, Vancouver, British Columbia.	"Labour Arbitration in B.C."	\$ 1,200.00
MCLEOD, T.H.M., University of Saskatchewan, Saskatoon, Saskatchewan.	"Settlement of Industrial Disputes in Public Agencies"	\$ 750.00
	Total	\$ 6,050.00
<u>1960-1961</u>		
BROMKE, A., McGill University, Montreal (Quebec)	"The Labour Relations Board in Ontario as an Administrative Tribunal"*	\$ 800.00
HALL, Noel A., University of British Columbia, Vancouver, British Columbia.	"The Role of the Union Business Agent"	\$ 1,000.00
JAMIESON, Stuart, University of British Columbia, Vancouver, British Columbia.	"Conflict and Disputes Settlement in the Building Construction Industry of B.C."*	\$ 1,700.00
LUCIER, J., University of Montreal, Montreal (Quebec).	"Centralization or Decentralization of the Industrial Relations Function in Large Canadian Concerns"	\$ 1,200.00
OSTRY, Mrs. S., McGill University, Montreal (Quebec).	"The Impact of Collective Bargaining on Wages"*	\$ 300.00
	Total	\$ 5,000.00
<u>1961-1962</u>		
ARTHURS, H.W., Osgoode Hall, Toronto, Ontario.	"Labour Law in Denmark"*	\$ 500.00

* Published, see Appendix attached

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
<u>1961-1962</u>		
JGUSHESKI, S.T. McGill University, Montreal (Quebec).	"Examination of Human Re-organization Within a Firm Undergoing Technological Change"	\$ 1,500.00
HEBERT, Gerard, McGill University, Montreal (Quebec).	"Juridical Extension of Collective Agreements in the Quebec Building Industry"*	\$ 400.00
LUCIER, J., University of Montreal, Montreal (Quebec).	"Centralization or Decentralization of the Industrial Relations Function in Large Canadian Concerns"	\$ 400.00
MARION, G., University of Montreal, Montreal (Quebec).	"Changes in the Occupational Wage Structure"*	\$ 1,500.00
YOUNG, F.J.L., Queen's University, Kingston, Ontario.	"Contracting Out"*	\$ 1,500.00
Total		\$ 5,800.00
<u>1962-1963</u>		
ADELL, Bernard Leo, Wadham College, Oxford University.	"Legal Status of Collective Agreements in Canada, the U.S.A. and Great Britain"	\$ 2,500.00
AIRD, David C., University of British Columbia, Vancouver, British Columbia.	"Effective Utilization of Manpower In the Canadian Construction Industry"*	\$ 1,000.00
FERGUSON, Agnes M., McGill University, Montreal (Quebec).	"Scientific Manpower in the Economy of Canada"	\$ 1,000.00
HARTT, Stanley, McGill University, Montreal (Quebec)	"Origins of the Legislative Policy of Quebec in Labour Relations Matters"	\$ 1,200.00
KELLY, L.A., Queen's University, Kingston, Ontario.	"Economic Analysis of Financing Unemployment Insurance in Canada"	\$ 1,500.00
MARION, G., University of Montreal, Montreal (Quebec).	"Wage Differentials in Canada"*	\$ 1,000.00
WOODFINE, W.J., St. Francis-Xavier University, Antigonish, Nova Scotia.	"Labour Implications of Recent Developments in the Coal Mining Industry of Nova Scotia"	\$ 500.00
Total		\$ 8,700.00

* Published, see Appendix attached

Name and University of Researcher	Title 1963-1964	Amount Granted
BELAND, Richard, University of Montreal Montreal (Quebec).	"Forecasting of the Manpower Market Conditions by Occupations for the Province of Quebec over the Next Decade"	\$ 1,500.00
BLAKE, Gordon, United College, Winnipeg, Manitoba.	"Industrial Relations and Other Aspects of the Construction Industry of Manitoba"	\$ 700.00
CRAIG, Alton W., Cornell University, Ithaca, New York.	"The Impact of Provincial Jurisdiction on the Progress of National Collective Bargaining in Canada: A Case Study of the Packinghouse Industry"	\$ 1,200.00
Gonick, C.W., University of Saskatchewan, Saskatoon, Saskatchewan.	"Depressed Areas in Canada"	\$ 1,500.00
GOODWIN, John Howard, London School of Economics.	"The Role of Labour-Management Co-operation in Industrial Relations"	\$ 1,000.00
HAYES, Francis Joseph, Loyola College, Montreal (Quebec).	"Student Summer Employment in Canada"*	\$ 1,200.00
LUNGSTRASS, H.W., University of Alberta, Edmonton, Alberta.	"Relocation of Industries in Canada"	\$ 495.00
MCFARLANE, Bruce A., Carleton University, Ottawa, Ontario.	"The University and Occupational Choice"	\$ 2,500.00
PEITCHINIS, Stephen Gabriel, University of Western Ontario, London, Ontario.	"The Impact of the Changing Structure of the Labour Force on Labour's Share of the National Income"*	\$ 800.00
PILLAI, N.G., Loyola College, Montreal (Quebec)	"The Structure of Labour Unions and the Patterns of Industrial Disputes Settle- ment in Newfoundland"	\$ 1,000.00
SIDLOFSKY, Samuel, University of Toronto, Toronto, Ontario.	"The Changing Urban Structure and Post- War Immigrants, with Special Reference to Toronto's Italian Population"	\$ 1,500.00

* Published, see Appendix attached

Name and University of Researcher	Title	Amount Granted
STAGER, David A.A., Princeton University, inceton, New Jersey.	"Economics of Higher Education"	\$ 1,300.00
	Total	\$14,695.00
<u>1964-1965</u>		
CRAIG, Alton W.J., Christ the King College, London, Ontario.	"The Consequences of Provincial Jurisdiction for the Process of Company-Wide Collective Bargaining in Canada: A Study of the Packinghouse Industry"	\$ 1,000.00
DOWNIE, Bryan M., University of Chicago, Chicago, Illinois.	"An Analysis of the Impact on Wages and Fringe Benefits of International Unions Bargaining in Canada: Experience in Six Industries"*	\$ 2,000.00
GOODWIN, John Howard, University of London.	"White-Collar Unionization: A Study of the Banks, the Staff Associations and a National Union of Bank Employees"	\$ 1,000.00
GREEN, Peter Garfield, Dalhousie University, Halifax, Nova Scotia.	"Labour Management Relations in the Construction Industry"*	\$ 1,500.00
ISBESTER, A. Fraser, Cornell University, Ithaca, New York.	"Bibliography and Source Materials on Canadian Industrial and Labour Relations"*	\$ 800.00
JAIN, Hem C., University of New Brunswick, Fredericton, New Brunswick.	"Industrial Relations and Dispute Settlement in the Pulp and Paper Industry in Eastern Canada, 1950-1960"	\$ 2,000.00
KLEIN, Sandor Jack, McGill University, Montreal (Quebec).	"The Treatment of Public Interest Disputes in the Province of Quebec and the Attitudes and Philosophy which led to such Treatment"	\$ 1,500.00
MANN, Edward William, University of Western Ontario, London, Ontario.	"An Investigation of the Drop-Out Ratio from the Federal Government's Retraining Program for Unemployed Workers"	\$ 1,500.00
MCFARLANE, Bruce A., Carleton University, Ottawa, Ontario.	"The University and Occupational Choice"	\$ 2,500.00
MIGUE, Jean-Luc, Universite Laval, Quebec (Quebec)	"The Relation of Skilled to Unskilled Wages (with special reference to Canada)"	\$ 1,800.00

* Published, see Appendix attached

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
POLIANSKI, Alexei Nicholas, University of Pennsylvania, Philadelphia, Pennsylvania.	"Development of a Short-Run (6, 9, 12 months) Forecasting Model of Overall Participation in the Canadian Labour Force"	\$ 1,500.00
PORTER, John, and PINEO, Peter, Carleton University, Ottawa, Ontario.	"Public Evaluation of Occupations in Canada"*	\$ 4,000.00
WILLIAMS, C. Brian, Ithaca University,	"Bi-National Unionism and the Canadian Union Movement, 1880-1920"*	\$ 1,800.00
	Total	\$22,900.00
<u>1965-1966</u>		
BRODY, Bernard, McGill University, Montreal (Quebec)	"The Behavior of Industrial Conflicts (Strikes) in Canada, Quebec, Ontario and British Columbia; 1937-1964"	\$ 500.00
COATES, Norman, School of Industrial and Labour Relations, Cornell University, Ithaca, New York.	"Industrial Relation Implications of Canadian-U.S. Economic Integration: the Automobile Industry as a Case Study"	\$ 3,000.00
COULOMBE, Pierre E., Universite d'Ottawa, Ottawa, Ontario.	"Sociologie du Travail des Organisations"	\$ 2,500.00
CRISPO, KRUGER and MELTZ, University of Toronto, Toronto, Ontario.	"A Theoretical Framework for Analyzing the Operation of the Labour Market"	\$ 4,000.00
GROSS, Andrew Charles, University of Saskatchewan Saskatoon, Saskatchewan.	"An Economic Profile of a Skilled Occupation in a Developed Country"	\$ 90.00
HOGAN, Andrew (Rev.), St. Francis Xavier University, Antigonish, Nova Scotia.	"Voluntary Pension Plan by the Provincial Government, as a Partial Solution to the Closure of Three Coal Mines in the Sydney, Cape Breton Area, 1960-61"	\$ 710.00
ISBESTER, A. Fraser, Cornell University, Ithaca, New York.	"History of the Catholic Labour Movement in Quebec"	\$ 2,500.00
JONGERIUS, Theodore I., Universite d'Ottawa Ottawa, Ontario.	"The Labour-Management Climate in Large Canadian Hospitals"	\$ 1,000.00
MELTZ, Noah M., University of Toronto, Toronto, Ontario.	"Canadian Political Science Association Committee on Occupational Classification"	\$ 500.00

* Published, see Appendix Attached

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
<u>1965-1966</u>		
RTER, John and LINEO, Peter, Carleton University, Ottawa, Ontario.	"The Public Evaluation of Occupations"*	\$ 5,000.00
PROULX, Pierre-Paul, McGill University, Montreal (Quebec).	"Labour Force Participation and Unemployment"	\$ 2,700.00
SIDLOFSKY, Samuel, University of Manitoba, Winnipeg, Manitoba.	"Post-War Immigrants in the Changing Metropolis with Special Reference to Toronto's Italian Population"	\$ 1,500.00
THOMAN, Richard S., Queen's University, Kingston, Ontario.	"Journey to Work Study by National Employment Service Areas"	\$ 3,000.00
WAHN, Edwin V., University of Saskatchewan, Saskatoon, Saskatchewan.	"The Existing Law in the Common Law Provinces of Canada Relating to the Lawfulness of 'Peaceful' Secondary Boycotts and Secondary Picketing"	\$ 712.50
Total		\$27,712.50
<u>1966-1967</u>		
ALIX, Jean-Pierre, John Hopkins University, Baltimore, Maryland.	"The intercommunity propensity to strike - A sociological analysis of industrial conflict in Canada from 1901 to 1963".	\$ 4,965.00
BEAMAN, Jay, University of Saskatchewan, Saskatoon, Saskatchewan.	"Labour Force and Migration in Canada."	\$ 2,900.00
BELAND, Richard, Université de Montréal, Montréal, Québec.	"Méthode de prévision de la demande en main-d'oeuvre selon les occupations".	\$ 5,000.00
BELL, Joel, McGill University, Montreal, Quebec.	"Problems arising from the practice of "contracting out" in the setting of current labour legislation".	\$ 2,500.00

* Published, see Appendix attached

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
CARMENT, David William, McMaster University, Iilton, Ontario.	"The effects of unequitable payment on performance, job satisfaction, and inter-personal relationships".	\$ 3,350.00
CHAMBERS, David Arthur, University of Western Ontario, London, Ontario.	"An appraisal of the skills and work potential of mental health patients".	\$ 3,500.00
COATES, Norman, Cornell University, Ithaca, New York.	"Industrial relations implications of Canadian-U.S. economic integration: the automobile industry as a case study".	\$ 2,000.00
COHEN, Dian, McGill University, Montreal, Quebec.	"Statistical analysis of cost-benefit studies related to education".	\$ 4,500.00
CRYSDALE, Stewart, University of Toronto, Toronto, Ontario.	"Occupational mobility: rural versus city-bred workers".	\$ 3,000.00
CURTIS, C.H., Queen's University, Kingston, Ontario.	"The arbitration of union-management grievances in Canada".	\$ 2,000.00
EASTMAN, Mervyn N., University of Alberta, Edmonton, Alberta.	"An analysis of the dimensions relevant to the attitudes expressed by business executives and union leaders concerning self and each other".	\$ 1,000.00
EOLL, George Kenneth, University of Wisconsin, Madison, Wisconsin.	"Conflict and co-operation in industrial and commercial organizations".	\$ 2,000.00
FLOOD, Maxwell, Michigan State University, Ann Arbor, Michigan.	"A study of wild-cat strikes in Canada".	\$ 5,000.00
GIBSON, David, University of Calgary, Calgary, Alberta.	"Predicting Vocational Success for the mentally retarded adult".	\$ 4,000.00
HERSH, Larry, Harvard University, Cambridge, Massachusetts.	"An analytical and empirical study of the effects of the introduction of overtime premium rates".	\$ 2,000.00
Jewish Vocational Service, 152 Beverley Street, Toronto 2B, Ontario.	"The measurement of affective and attitudinal changes in emotionally handicapped clients served in a vocational rehabilitation centre and its use in the prediction of outcome and long-term work adjustment".	\$14,625.00

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
JUDEK, Stanislaw, University of Ottawa. Ottawa, Ontario.	"Study of the utilization of womanpower in the government service".	\$ 1,800.00
KALISKI, Stephen Felix, Carleton University, Ottawa, Ontario.	"Investigation of structural unemployment".	\$ 2,000.00
KOVACS, Aranka E., University of Windsor, Windsor, Ontario.	"The Theory of the Canadian labour movement".	\$ 1,600.00
LEMELIN, Claude, McGill University, Montreal, Quebec.	"Language and mobility of the labour force in Canada".	\$ 3,400.00
MacDOWELL, G.F., Brandon College, Brandon, Manitoba.	"Study of the Brandon Packers' Strike".	\$ 1,000.00
McKEAN, John Richard, University of Alberta. Edmonton, Alberta.	"The economic return on investment in formal education for various occupation classifications".	\$ 1,200.00
NAGLER, Mark, University of Toronto, Toronto, Ontario.	"The urbanization of Indians and related consequences".	\$ 4,320.00
NICHOLSON, John J., University of Toronto, Toronto, Ontario.	"Comparative study of the adjusted and non-adjusted migrant from Cape Breton to the urban Toronto Area".	\$ 1,200.00
PARAI, Louis, University of Western Ontario, London, Ontario.	"A study in short-term fluctuations in Canadian international migration, 1964-65".	\$ 1,700.00
PARSONS, Phylis B.J., University of Alberta, Edmonton, Alberta.	"The development of collective bargaining in the nursing profession in the province of Alberta".	\$ 2,500.00
PLUMPTRE, A.F. Wynne, University of Toronto, Toronto, Ontario.	"A statistical study of the socio- economic factors which affect university enrollment of college-age persons in Scarborough Township".	\$ 1,250.00
PROULX, Pierre-Paul, McGill University, Montreal, Quebec.	"An analysis of the level and composition of unemployment in Canada".	\$ 2,500.00
SAINT-AMAND, André, University of Montreal, Montreal, Quebec.	"Les appareils de direction d'une fédéra- tion syndicale "internationale" dans un contexte québécois: dimensions politiques, économiques et culturelles".	\$ 3,500.00

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
SAINT-PIERRE, Céline, University of Montreal, Montreal, Quebec.	"L'introduction de la négociation collective dans la Province de Québec ou les débuts du syndicalisme industriel québécois".	\$ 2,500.00
SAWYER, John A., University of Toronto, Toronto, Ontario.	"A study of the Canadian labour market within an econometric model of the Canadian economy".	\$11,000.00
TREMBLAY, Louis-Marie, University of Montreal, Montreal, Quebec.	"La recherche en relations industrielles dans les universités canadiennes depuis 1960".	\$ 3,000.00
URQUHART, M.C., Queen's University, Kingston, Ontario.	"An economic analysis of some aspects of population movements".	\$ 5,000.00
WOOD, W. Donald, Queen's University, Kingston, Ontario.	"The changing structure of bargaining units and collective bargaining".	\$10,600.00
WOODS, H.D., McGill University, Montreal, Quebec.	"The role of government in the labour market".	<u>\$ 2,000.00</u> <u>\$124,410.00</u>
Canadian Federation of University Women		<u>11,000.00</u> <u>\$135,410.00</u>
<u>1967-1968</u>		
ABELLA, Irving Martin, University of Toronto, Toronto, Ontario.	"The CIO in Canada, 1936-1956"	\$ 5,000.00
ALIX, Jean-Pierre, John Hopkins University, Baltimore, Maryland.	"An intercommunity propensity to strike - A study on the occupational mobility of the Canadian Labour Force"	\$ 5,000.00
CARMENT, David William, McMaster University, Hamilton, Ontario.	"The effects of inequitable payment on performance, job satisfaction and interpersonal relationships"	\$ 3,650.00
DESCOTEAUX, Gaston, University of Ottawa, Ottawa, Ontario.	"Decisions of the Canada Labour Relations Board and of the Quebec Labour Relations Board"	\$ 5,000.00
DONALD, Marjorie D., Carleton University, Ottawa, Ontario.	"Communication and influence in decision-making groups"	\$ 4,750.00

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
1967-1968		
EOLL, George Kenneth, University of Wisconsin, Madison, Wisconsin.	"Conflict and Co-operation in industrial and commercial organization"	\$ 1,200.00
GARDNER, Robert C., University of Western Ontario, London, Ontario.	"Labour and Management Stereotypes of Ethnic Groups"	\$ 1,867.00
GUEST, Dennis Trevor, London School of Economics and Political Science, London, England.	"Developments in Canada's Income Maintenance Programs since 1945"	\$ 500.00
KELLY, Laurence A., Queen's University, Kingston, Ontario.	"Social Security Systems - An International Comparison"	\$ 4,000.00
KOVACS, Aranka E., University of Windsor, Windsor, Ontario.	"A Theory of the Canadian Labour Movement"	\$ 1,600.00
KUMAR, Pradeep, Queen's University, Kingston, Ontario.	"An Annotated Bibliography of Canadian Graduate Theses in Industrial Relations"	\$ 3,000.00
MARION, Gérald, Université de Montréal, Montréal, P.Q.	"Industrial Wage Structure"	\$ 5,000.00
McCAFFREY, Gordon Grant, York University, Toronto, Ontario.	"Jurisdictional disputes between craft unions and between craft and industrial unions, with special reference to the impact of technological change"	\$ 1,500.00
PALEKAR, S.A., Sir George Williams University, Montreal, P.Q.	"Real Wages in Canada 1926-66"	\$ 2,500.00
PROULX, Pierre-Paul, Université de Montréal, Montréal, P.Q.	"Strikes and the Business Cycle"	\$ 2,000.00
REVELL, J. Joseph, St. Dunston's University, Charlottetown, P.E.I.	"Dispute settlement in the food processing industry, with particular reference to highly seasonal operations"	\$ 2,000.00

<u>Name and University, of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
ROBACK, Leo, University of Montreal, Montreal, P.Q.	"The Shop Steward in a Large Industrial Union"	\$ 5,000.00
ROSSMAN, Hart, University of Toronto, Toronto, Ontario.	"The Rights and Remedies of the Individual Employee in Grievance and Arbitration Procedures"	\$ 4,000.00
SAINT-AMAND, André, Université de Montréal, Montréal, P.Q.	"Les appareils de direction d'une Fédération syndicale "internationale" dans un contexte québécois: dimensions politiques, économiques et culturelles"	725.00
STRICK, John C., University of Windsor, Windsor, Ontario.	"Collective Bargaining and Secondary School Teachers - the Windsor Case"	\$ 1,200.00
TREMBLAY, Louis-Marie, Université de Montréal, Montréal, P.Q.	"La recherche en relations industriel- les dans les universités Canadiennes depuis 1960"	\$ 1,800.00
VAN LOON, R.J. Queen's University, Kingston, Ontario.	"Structure and Ideology: The Relationship Between Two changing Aspects of the Confédération des Syndicats Nationaux"	\$ 2,250.00
WALLIN, Herman A., University of British Columbia, Vancouver, B.C.	"Patterns of Administrator Involvement with Collective Negotiations in Selected Public Agencies in Western Canada".	\$ 3,000.00
WESTLEY, William A., McGill University, Montreal, Que.	"A History and Analysis of Labour's Organizational Drives and Strikes in Quebec from 1929-1949".	\$ 5,000.00
WOOD, W. Donald, Queen's University,	"The Evolution of White-Collar Unionism"	\$ 5,000.00
	Sub-total	\$ 76,542.00

AWARDED IN MARCH 1968

CRYSDALE, Stewart, York University, Toronto, Ontario.	"Mobility Channels in Riverdale - a Blue-collar Community".	\$ 2,500.00
JEWISH VOCATIONAL SERVICES, 152 Beverly Street, Toronto, Ontario.	"The measurement of affective and attitudinal changes in emotionally handicapped clients served in a vocational rehabilitation centre and its use in the prediction of outcome and long-term work adjustment".	\$ 3,000.00

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
<u>AWARDED IN MARCH 1968</u>		
FRONTIER COLLEGE' Toronto, Ontario.	"A study of labour-management relations among selected industries served by Frontier College, designed to assist in evaluating its objectives and programs to meet present day needs"	\$ 5,000.00
MARION, Gerald, University of Montreal, Montreal, P.Q.	"Industrial Wage Structure"	\$ 3,000.00
VAN LOON, Mrs. R.J., Queen's University, Kingston, Ont.	"Structure and Ideology: The Relationship between Two Changing Aspects of the Confédération des Syndicats Nationaux".	\$ 2,750.00
WOOD, W. Donald,	"Evolution of White-Collar Unionism"	\$ 5,000.00
	Sub-total	\$ 21,250.00
	Total	\$ 97,792.00
Canadian Federation of University Women		1,000.00
		\$ 98,792.00
<u>1968-1969</u>		
ALVI, S.A., Loyola College, Montreal, P.Q.	"Functional Income Distribution in Postwar Canada (1946-67)"	\$ 1,850
ANGUS, James T., University of Alberta, Edmonton, Alberta.	"An examination of the dynamics of organized negotiation as a process of conflict resolution in a study of the issue of evaluation of teacher education in Alberta".	\$ 2,500.00
CAMPBELL, Douglas F., St. Francis Xavier, Antigonish, N.S.	"The Steelworker and an Economy in Crisis"	\$ 3,600.00
CARROLL, William J., University of Guelph, Guelph, Ont.	"Production, Employment and Technological Change - A case study of eight industries in Canada, 1949-1966".	\$ 5,000.00
CRYSDALE, Stewart, York University, Toronto, Ont.	"Mobility Channels in Riverdale - a Blue-collar Community".	500.00
DAVID, Hélène, University of Montreal, Montreal, P.Q.	"Les grèves au Québec depuis 1945, une analyse sociologique."	\$ 4,800.00

<u>Name and University of Researcher</u>	<u>Title</u>	<u>Amount Granted</u>
<u>1968-1969</u>		
RON, Gérard, Laval University, Quebec, P.Q.	"Lexique français en relations de travail"	\$ 5,000.00
DONALD, Marjorie, Carleton University, Ottawa, Ontario.	"Communication and Power in Negotiation Groups".	\$ 2,000.00
DYCK, Harold, University of British Columbia.	"Labour-Management Relations in Research Organizations".	\$ 4,760.00
FREIHEIT, Mortimer G., McGill University, Montreal, P.Q.	"Law of Evidence and Procedure in the Arbitration of Grievances"	\$ 3,500.00
KELLY, Laurence A., Queen's University, Montreal, P.Q.	"Unemployment Insurance in Canada"	\$ 4,000.00
KUMAR, Pradeep, Queen's University, Kingston, Ontario.	"Variations in the Labour Share of National Income in Canada"	\$ 2,900.00
MATTHIASSEN, John S., University of Manitoba, Winnipeg, Man.	"Factors Related to Rapid Personnel Turnover in Northern Single-Enterprise Communities".	\$ 5,000.00
MCCORMACK, Andrew R., University of Western Ontario, London, Ontario.	"Winnipeg Labour Politics: 1899-1917"	\$ 1,200.00
PALMER, E.E., University of Western Ont., London, Ontario.	"Responsible Decision Making in Democratic Trade Unions."	\$ 1,800.00
SWARTZ, Gerald S., University of Toronto, Toronto, Ontario.	"Collective Bargaining in Toronto Secondary Schools."	\$ 3,000.00
TAYLOR, Leroy O., York University, Toronto, Ontario.	"An Enquiry Into the Determination of Wages and Prices in Canada: A disaggregated study (1953-	\$ 5,000.00
TREMBLAY, Louis-Marie, University of Montreal, Montreal, Que.,	"La recherche en relations industrielles dans les universités canadiennes depuis 1940".	\$ 500.00
WALLIN, Herman A., University of British Columbia, Vancouver, B.C.	"Patterns of Administrator Involvement with Collective Negotiations in Selected Public Agencies in Western Canada".	<u>\$ 3,100.00</u> \$ 60,010.00

APPENDIX

Department of Labour-University Research Program1951-1967

<u>Author</u>	<u>Title of Research Project Supported</u>	<u>Publication</u>
Aird, David C.	"Effective Utilization of Manpower in the Canadian Construction Industry"	<u>Manpower Utilization in the Canadian Construction Industry (A Pilot Study)</u> , Ottawa, National Research Council, Division of Building Research, Technical Paper No. 156, September 1963.
Anton, F.R.	"Government Supervised Strike Votes"	<u>Government Supervised Strike Votes</u> , Toronto, CCH Canadian Limited, 1961, vi-190 pp.
Armstrong, D.E.	"Examination of Collective Bargaining in the Coal Industry in Alberta"	-----, Muriel Armstrong, "Third Party Intervention in the Alberta Coal Industry 1900-1951", pp. 23-88 in <u>Patterns of Industrial Dispute Settlement in Five Canadian Industries</u> ", H.D. Woods (ed.), Montreal, Industrial Relations Centre, McGill University, 1958, vi-397 pp.
Arthurs, H.W.,	"Labour Law in Denmark"	"Labour Lore and Labour Law: A North American View of the Danish Experience" <u>The International and Comparative Law Quarterly</u> , January 1963.
Bouchard, Maurice	"Economic Interpretation of Collective Agreements"	<u>Théorie du Salaire et Conventions Collectives</u> , Montréal, Faculté des Sciences Sociales Economiques et Politiques, Université de Montréal 1957, 329 pp.
Brecher, M.	"Men's Garment Industry" Patterns of Accommodation in the Quebec Men's Garment Industry"	"Pattern of Accommodation in the Men's Garment Industry of Quebec 1914-1954", pp.89-186, in <u>Patterns of Industrial Dispute Settlement in Five Canadian Industries</u> , H.D. Woods (ed.), Montreal, Industrial Relations Centre, McGill University, 1958, vi-397 pp.

1951-1967

<u>Author</u>	<u>Title of Research Project Support</u>	<u>Publication</u>
B. Omke, A.	"The Labour Relations Board in Ontario as an Administrative Tribunal"	<u>The Labour Relations Board in Ontario: A Study of the Administrative Tribunal</u> , Montreal, Industrial Relations Centre, McGill University, 1961, 104 pp.
		"The Changing Role of the Ontario Labour Relations Board" <u>Canadian Public Administration</u> , vol. 111 December, 1960, pp. 312-321.
Carrothers, A.W.R.	"The Labour Injunction in B.C. 1946-1955"	<u>The Labour Injunction in British Columbia: A Study of the Operation of the Injunction in Labour-Management Disputes in British Columbia 1946-1955</u> , Toronto, CCH Canadian Limited, 1956, xxvii-276 pp.
Carrothers, A.W.R.	"A Comparison and Critical Annotation of Canadian Collective Bargaining Statutes"	<u>Collective Bargaining Law in Canada</u> , Toronto, Butterworths 1965, lxxxix-553 pp.
		<u>Labour Arbitration in Canada: A Study of the law and practice relating to the arbitration of grievance disputes in industrial relations in common law Canada</u> , Toronto, Butterworths 1961, xxx-204 pp.
Curtis, C.H.	"Rules of Procedure and Practises in Arbitrations under Agreements in Ontario."	<u>Labour Arbitration Procedures: A study of the procedures followed in the arbitration of union-management disputes in the manufacturing industries of Ontario</u> , Kingston, Department of Industrial Relations, Queen's University, 1957, ii-90 pp.
Downie, Bryan M.	"An Analysis of the Impact on Wages and Fringe Benefits of International Unions Bargaining in Canada: Experience in Six Industries"	"International Union Influence on Collective Bargaining in Canada" pp. 98-120, in <u>Proceedings of Sixteenth Annual Conference</u> , September 9, 10, 196 Shirley B. Goldenberg (ed.), Montreal Industrial Relations Centre, McGill University.

1951-1967

<u>Author</u>	<u>Title</u> <u>Research Project Supported</u>	<u>Publication</u>
ankel, Saul J.	"Employer-Employee Relations in the Canadian Federal Civil Service"	<u>Staff Relations in the Civil Service, The Canadian Experience.</u> Montreal, McGill University Press 1962, ix-331 pp.
Green, Peter G.	"Labour-Management Relations in the Construction Industry"	<u>Labour-Management Relations in the Construction Industry in Nova Scotia, Halifax, Institute of Public Affairs, Dalhousie University, 1965, pp. 1-60.</u>
Hayes, Francis J.	"Student Summer Employment in Canada"	<u>Student Summer Employment in Canada, Montreal, N.F.C.U.S. Committee at Loyola College, 1963, pp. 1-34.</u>
Hebert, Rev. Gerard	"Juridical Extension of Collective Agreements in the Quebec Building Industry."	"L'Extension juridique et les métiers de la construction au Québec", <u>Relations Industrielles-Industrial Relations</u> , Vol. 18, No. 3, juillet 1963, pp. 299-313.
Isbester, Fraser	"Bibliography and Source Material on Canadian Industrial and Labour Relations"	-----, Daniel Coates, Brian Williams, <u>Industrial and Labour Relations in Canada: A Selected Bibliography</u> , Kingston, Ontario, Industrial Relations Centre, Queen's University, 1965, 120 pp.
Jamieson, S.	"Settlement of Building Trades Disputes in B.C."	"Labour Disputes Settlement in the Construction Industry of British Columbia, 1948-1954" pp. 187-262, in <u>Patterns of Industrial Dispute Settlement in Five Canadian Industries</u> , H.D. Woods, (ed.), Montreal, Industrial Relations Centre, McGill University, 1958, vi-397 pp.
Logan, H.A.	"The Effect of Third Party Intervention on the Process of Bargaining"	<u>State Intervention and Assistance in Collective Bargaining: The Canadian Experience 1943-1954</u> , Toronto, University of Toronto Press, 1956, vii-176 pp.

1951-1967

<u>Author</u>	<u>Title</u> <u>Research Project Supported</u>	<u>Publication</u>
Lalor, G.	"Changes in Occupational Wage Structure" "Wage Differentials in Canada"	"L'offre de travail et la disparité occupationnelle des salaires en longue période", <u>L'Actualité Economique</u> , Vol. 39, No. 2, July-September, 1963, pp. 199-239. <u>Répartition fonctionnelle des revenus</u> , Montreal, Presses de l'Université de Montréal, 1965 125 pp.
Mehling, Jean	"Labour Management Relations in the Metal Mining Industries of the Province of Quebec"	<u>Analyse Socio-Economique d'une Grève</u> , Montreal, Les Presses de l'Ecole des Hautes Etudes Commerciales, Les Editions de Librairie Beauchemin Limitée, 1963.
Oliver, Micheal	"Third Party Intervention in the Quebec Textiles Industry"	"Third Party Intervention in the Quebec Primary Textile Industry 1944-1952", pp. 263-324 in <u>Patterns of Industrial Dispute Settlement in Five Canadian Industries</u> ", H.D. Woods (ed.), Montreal, Industrial Relations Centre, McGill University, 1958, vi-397 pp.
Ostry, Sylvia	"The Impact of Collective Bargaining on Wages"	"Wages in Canada: The Inter-Industry Structure", pp. 448-467 in H.D. Woods and Sylvia Ostry, <u>Labour Policy and Labour Economics in Canada</u> , Toronto, MacMillan 1962, xvii-533 pp.
Peitchinis, Stephen G.	"The Impact of the Changing Structure of the Labour Force on Labour's Share of the National Income"	<u>The Economics of Labour: Employment and Wages in Canada</u> , Toronto, McGraw-Hill Co., 1965, 412 pp.
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APPENDIX D

- INFORMATION SYSTEM DEVELOPED IN THE AREA OF COLLECTIVE AGREEMENT ANALYSIS
- A MODEL FOR THE ANALYSIS OF INDUSTRIAL RELATIONS SYSTEMS
- WAGES AND COSTS IN CANADIAN INDUSTRY
- METHOD OF CALCULATION OF INDEX NUMBERS

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| 141 | COMPULSORY RESIGNATION OF EMPL. AFTER MARRIAGE WITH ANOTHER EMPL. | |

MANUFACTURING - NON-OFFICE

CODING SHEET - Page 1

CARD 1 - START

--

1 (1) ILM CARD NUMBER	1				
2 (2-5) INDUSTRY					
3 (6) PROVINCE					
4 (7-10) LOCATION					
5 (11-13) ESTABLISHMENT NUMBER					
6 (14) UNIT					
7 (15-19) NUMBER OF EMPLOYEES COVERED					
8 (20-22) UNION					
9 (23) TERM OF AGREEMENT					
10 (24-26) EXPIRY DATE					
11 (27) WAGE REOPENERS					
12 (28) PART-TIME EMPLOYEES					
13 (29) UNION SECURITY - MEMBERSHIP					
14 (30) UNION SECURITY - CHECK-OFF					
15 (31) UNION SECURITY - PREFERENTIAL HIRING					
16 (32) UNION MEMBERSHIP - ADMISSION AND DISCHARGE					
17 (33) GRIEVANCE PROCEDURE - FIRST STEP					
18 (34) UNION GRIEVANCE					
19 (35) EMPLOYER GRIEVANCE					
20 (36) GRIEVANCE PROCEDURE IN DISMISSAL CASES					
21 (37) COMPENSATION FOR GRIEVANCE WORK					
22 (38) SCOPE OF ARBITRATION					
23 (39) ARBITRATION - NUMBER OF ARBITRATORS					
24 (40) SENIORITY ON PROMOTION					
25 (41) SENIORITY ON LAY-OFF					
26 (42) RETENTION OF SENIORITY DURING TERM OF LAY-OFF					
27 (43) PREFERENTIAL TREATMENT FOR UNION OFFICIALS IN CASE OF LAY-OFF					



MANUFACTURING - NON-OFFICE

CODING SHEET - Page 3

CARD 2 - START

54 (1) IBM CARD NUMBER	2				
55 (2-5) INDUSTRY					
56 (6) PROVINCE					
57 (7-10) LOCATION					
58 (11-13) ESTABLISHMENT NUMBER					
59 (14) UNIT					
60 (15-19) NUMBER OF EMPLOYEES COVERED					
61 (20-22) UNION					
62 (23) PAID VACATIONS - GENERAL					
63 (24) PAID VACATIONS - TWO WEEKS					
64 (25-26) PAID VACATIONS - THREE WEEKS					
65 (27-28) PAID VACATIONS - FOUR WEEKS					
66 (29-30) PAID VACATIONS - FIVE WEEKS					
67 (31) COST OF LIVING BONUS					
68 (32) WAGE INCENTIVES					
69 (33) PROFIT SHARING					
70 (34) CHRISTMAS BONUS					
71 (35) JOINT JOB EVALUATION					
72 (36) FREQUENCY OF PAY-DAYS					
73 (37) METHOD OF PAYMENT					
74 (38) SICK PAY					
75 (39) REST PERIODS					
76 (40) PAID MEAL PERIODS					
77 (41) PAID MEALS					
78 (42) PAID WASH-UP TIME					
79 (43) INJURY ALLOWANCE					



MANUFACTURING -- NON-OFFICE

CODING SHEET - Page 4

CARD 2 -- CONTINUED

80 (44) PAID LEAVE OF ABSENCE -- DEATH IN FAMILY	
81 (45) PAID LEAVE OF ABSENCE -- ILLNESS IN FAMILY	
82 (46) PAID LEAVE OF ABSENCE -- JURY DUTY AND/OR COURT WITNESS	
83 (47) PAID LEAVE OF ABSENCE -- OTHER	
84 (48) UNPAID LEAVE OF ABSENCE -- UNION BUSINESS	
85 (49) UNPAID LEAVE OF ABSENCE -- OTHER	
86 (50) WOMEN -- EQUAL PAY	
87 (51) WOMEN -- SEPARATE SENIORITY UNIT	
88 (52) WOMEN -- MATERNITY LEAVE	
89 (53) WOMEN -- REST PERIODS	
90 (54) OLDER AND/OR HANDICAPPED WORKERS	
91 (55) RETIRED WORKERS	
92 (56) CONTRACTING OUT	
93 (57) WORK STOPPAGES IN OTHER ESTABLISHMENTS	
94 (58) TECHNOLOGICAL CHANGE	
95 (59) MOONLIGHTING	
96 (60) RESTRICTIONS ON OVERTIME WORK	
97 (61) EDUCATION ALLOWANCE	

A MODEL FOR THE ANALYSIS OF INDUSTRIAL RELATIONS SYSTEMS

A Paper Presented to the Annual Meeting
of the
Canadian Political Science Association
June 7, 1967.

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Introduction*

In recent years the emerging discipline of industrial relations has been undergoing an agonizing appraisal both in terms of its subject matter and the methodology employed in its research. While studies in other social science disciplines such as economics, political science, and sociology have produced useful analytical research models and significant theoretical achievements, studies in industrial relations have been confined, with a few notable exceptions, to descriptive case studies, descriptive history, descriptions of collective agreement provisions, and formal analysis of statutory and common law developments. Where attempts have been made at some degree of generalization, these have been at the level of partial theory only. Unfortunately, the partial theories that have been developed have not yet been sufficiently integrated to provide even a minimum understanding of the totality of industrial relations behaviour.

* I wish to acknowledge my gratitude to Dr. S.M.A. Hameed, and Messrs. D.V. Brazier and R.J. Christy, three of my colleagues in the Canada Department of Labour, for their helpful comments on an earlier draft of this paper. Any views contained in this paper, whether expressed or implied, are strictly those of the author and do not necessarily reflect official thinking in the Canada Department of Labour.

The purpose of this paper is to articulate, however briefly, a conceptual model which, hopefully, will be useful for conducting analytical studies and, eventually, for unifying the various partial theories into a general theory of industrial relations. The model presentation here draws heavily on the works of a number of writers in various social science disciplines and, I hope, brings together a sufficient core of concepts for analyzing the totality of industrial relations behaviour.

Industrial Relations Systems Defined

Before proceeding to discuss the model itself, I would like to suggest that one of the reasons for the lack of any significant conceptual and theoretical developments in industrial relations is the fact that the discipline has never been defined in such a way as to give it some degree of central focus. Dunlop, who probably comes closer than anyone else in defining the domain of industrial relations, defines it almost strictly in structural terms. Nowhere, except in his contrast with the economic system, does he touch on its functional character. However, an adequate definition of the discipline must comprise both its structural and functional components.

For our purpose, then, industrial relations may be defined to include that complex of private and public activities, operating in an environment, which is concerned with the allocation of rewards to employees for their services. By referring to the complex of private and public activities, this definition embraces the whole gamit of structural arrangements whereby employee rewards are allocated, ranging from unilateral determination by the state or an employer to tripartite determination involving employers, unions, and public or private agencies. By referring to the rewards to employers for their services, this definition embraces not only material rewards, but also the psychological and social rewards which employees

receive in the performance of their services.

The Main Components of the Model

Taking the allocation of rewards to employees as the central focus of industrial relations, let me now proceed to set forth the rudiments of our model. As some of you will no doubt observe, I have utilized an input-output model of the type used by David Easton for the analysis of political life⁽¹⁾ (Our model is illustrated in graphic form in the diagram attached at the end of this paper.) Like any model, this one abstracts from empirical phenomena and attempts to capture in a nutshell the basic characteristics of industrial relations systems.

As you will observe, the model consists of four basic components: (1) inputs, summarized by the concepts of goals, values and power which are conditioned by the flow of effects from the environment sub-systems; (2) the mechanisms for converting the inputs into outputs; and (3) the outputs, comprising the financial, social and psychological rewards to employees; and (4) a feedback loop through which the outputs of the industrial relations system flow back into the environmental sub-systems. Let me now briefly discuss each of these components.

The Inputs of an Industrial Relations System

As implied above, the inputs of an industrial relations system come from two sources. First, there are the inputs from within the system itself, which are summarized by the concepts of

goals, values and power. Secondly, there is the flow of effects from the environmental sub-systems which becomes part of the inputs of the industrial relations system inasmuch as the environmental inputs condition the goals, values and power of the actors in the system. Let me now take a more detailed look at the nature of these two types of inputs.

Inputs from within the system itself

First, let us examine the inputs from within the system, or the within-puts. In order to discuss these we must first look at the actors in a system, i.e., those with whose activities we are concerned. The actors include individual workers in their role as workers, formal or informal organizations of workers, managers as individuals and as members of a management team, and government and private agencies and individuals. These are the actors whose goals, values and power constitute the inputs, and whose activities convert the inputs into outputs.

Goals refer to the objectives which an actor strives to achieve. Values refer to the norms or standards which an actor observes in establishing a hierarchy of objectives and the means of obtaining these objectives. Power refers to the ability of an actor to satisfy his needs or goals despite the resistance of others. Each actor in the system has his or its own particular set of goals and values. Speaking in a very general way, one might say that organized labour has a very pragmatic objective of obtaining more, more and more, as stated a long time ago by

Samuel Goppers. However, labour may be concerned with obtaining more of (x) rather than more of (y) so that it becomes a matter of deciding what emphasis shall be placed on the various alternative objectives or goals that labour seeks. In determining its goals, labour is guided by the norm of egalitarianism. This is the basic value or norm behind those objectives which labour seeks to achieve.

Management is likewise motivated by the objective of obtaining more, basically more profits, and is guided by the competitive norm. Government and private agencies, at least in this country, have until quite recently been guided by the goal of assisting the two private parties, i.e. labour and management, to achieve settlement of their disputes without work stoppages and without damage to the public interest. In recent years, however, government agencies involved in the industrial relations system in a number of countries, including the United States and Great Britain, have had very positive substantive objectives, taking the form of wage freeze, wage guidelines, or incomes policies. Hence, all three actors in the system have their own goals. While there is general agreement among all the actors on some goals, to the extent that the actors come from different sub-goal and value groups in our society, they will have their own distinct objectives and values. It is where these different goals and values clash that we find conflict among the actors in the system.

The power of any one of the actors, as was stated above, may be defined as the ability of that actor to obtain its objectives despite the resistance of others. The power of any

one of the three actors will vary according to conditions in the environment as well as conditions within the industrial relations system itself. For example, a very buoyant economy will give a good deal of power to labour whereas a slack economy will add to management's power. Also, a very militant union membership will give a good deal of power to the labour leader when he meets with his counterpart in management whereas an apathetic membership will not. Likewise the government, depending on the arsenal of weapons that it has at its control, may or may not have some degree of power. For example, the United States' government had considerable power over the other two parties in a number of industries last year when it released stockpiles of basic materials.

In summary, then, the goals, values and power of the actors in the industrial relations system constitute, in summary form, the input variables. However, as we stated at the beginning of this section, the inputs are of two types, namely, those from within the system and those which flow from the environment. Let us now take a look at the flow of effects from the environment as it becomes a conditioning input into the industrial relations system.

Flow of Effects from the Environment as Conditional Inputs into the Industrial Relations System

In referring to the environmental inputs as conditioning inputs, I am suggesting that the environmental inputs act to impose a range within which the outputs of the system must

fall. Specification of the outputs within that range, however, is determined by the goals, values and power of the actors within the system.

The environmental systems which have significant conditioning effects on the industrial relations system include the following: (a) the ecological system, (b) the economic system, (c) the political system, (d) the legal system, and (e) the social or cultural system. Let me now discuss each of these briefly, and in discussing each I will use only a few examples by way of illustration.

By the ecological system, I mean the physical surroundings in which man finds himself and the way in which he adjusts to these surroundings. For example, the natural resources of a country or region will have an impact on the inputs of the industrial relations system, inasmuch as they determine the structure of industry and the kinds of rewards that can be made. Also, climatic conditions will have an effect on the industrial relations system. For example, the climate in Canada is such that it closes our inland ports and slows down construction activities for a good part of the year. This, in turn, will lead the actors in these industrial relations systems to seek high rewards during the active season.

The economic system, comprising the product market, labour market, money market and technological innovation, also conditions the inputs of the industrial relations system. As mentioned previously, a period of high economic activity is a

condition which gives rise to relatively substantial inputs and, consequently, outputs, whereas a period of slow economic activity will produce inputs and outputs of a somewhat smaller and probably somewhat different nature. As I see it, the labour market acts to establish the minimum inputs and outputs whereas the product market establishes a ceiling. Also, monetary and fiscal policies, inasmuch as they operate to speed up or slow down economic activity, will likewise act as factors affecting the inputs of the industrial relations system. Technological change, by determining the kind of job hierarchies, the skills required and productivity changes, has its impact on the inputs of the industrial relations system through its effect on manpower requirement and the power of the actors in the system and the goals they attempt to achieve. Ideally it would be desirable to have summary variables representing the impact of the economic system on the inputs - and consequently the outputs - of the industrial relations system. As you probably know, Eckstein and Wilson use unemployment and profit rates as summary variables of the labour market and product market respectively in their analysis of money wage changes in American industry. (2)

The political system operates to influence the inputs of the industrial relations system in a variety of ways. First of all, the executive branch of the political system may play a direct role by taking action to see that the public interest is protected. This has been used frequently in the United States

and, as you know, in Canada as well. The political system also often operates through its legislative branch such as it did in Canada last summer when Parliament ordered the railway workers back to work with a minimum settlement which was subject to further negotiation or arbitration.

The legal system, comprising both common and statutory law, also has an effect on the inputs of the industrial relations system. First, by establishing procedural rules which the actors in the system must follow, the legal system prescribes or prohibits certain kinds of behaviour in converting the inputs into outputs. With the rash of illegal strikes during the past year, I need hardly remind you of the conflict that exists between the goals and values upon which so much of our common law rests and the goals and values of some of the actors in our Canadian industrial relations system. Secondly, labour standards legislation, including minimum wage laws, maximum hour laws and so on become conditioning inputs into the industrial relations system inasmuch as they establish a floor or a ceiling as the case may be.

The social system acts as a conditioning input into the industrial relations system in the very diffuse way. First, the actors in the industrial relations system are also part of the total social system, and consequently have assumed at least part of the main goal and value patterns of the broader social system.(3) It is this joint consensus on goals and values which keeps the system functioning smoothly. However, to the extent that there are sub-goal and value patterns within the general

social system from which the actors in the industrial relations system come, to this extent the social system will have a divisive impact as a conditioning input into the industrial relations system. Furthermore, expectations within the social system may put pressure on the political system to take action with respect to some problem in the industrial relations system. For example, if it is felt strongly that a dispute in a particular industry is disruptive to the whole society or an important segment thereof, pressure will emerge from the social system for the political system to take some action to resolve that dispute or to establish some guidelines which the actors in the industrial relations system must follow.

In summing up this section on environmental influences, I would like to suggest that one of the major tasks for those of us who are engaged in the emerging discipline of industrial relations is that of defining the precise role of the inputs from within the system (the behavioural inputs) and the precise role of the environmental influences which condition these inputs. Ideally, we should be able to develop quantitative measures of each of these and combine them into some kind of composite index. A very suggestive approach to this problem has been made by Dr. Hameed, one of my colleagues in the Canada Department of Labour, in an article which will appear in the July issue of the British Journal of Industrial Relations.⁽⁴⁾

Mechanisms for Converting Inputs into Outputs

Let me now turn to another part of the model, that of

the mechanisms for converting the inputs into outputs. These mechanisms may take various forms. First, the outputs may be determined unilaterally by one party alone, be it the employer or the state. This is true in our country, for example, in those firms or companies which are not yet unionized. Secondly, the inputs may be converted into outputs through bilateral negotiations between labour and management. Thirdly, the outputs may be determined by labour and management with the assistance of outside agencies, such as government or private mediators or arbitrators. This kind of three-way breakdown is a structural one. For our purposes, however, we will concentrate on the second and third structural types and discuss the various processes which organized labour and management may use for converting the inputs into outputs.

The most common process on the North American continent and most European countries is that of collective bargaining between labour and management, with government playing a mediatory role, at least most of the time. A great deal has been written about the collective bargaining process, about the mechanics of this process, the strategies which may be used by either of the parties, and the great emotional fanfare that accompanies the achievement of a contract settlement.⁽⁵⁾ However, one of the most significant books written on this subject in recent years is that of Walton and McKersie entitled a Behavioural Theory of Labour Negotiations⁽⁶⁾ which breaks the labour negotiation process down into four sub-processes, as

follows:

- (1) "distributive bargaining" which refers to those activities relating to the resolution of pure conflicts of interest;
- (2) "integrative bargaining" which refers to those activities which are concerned with the resolution of problems common to both parties and which increase the gains;
- (3) "intraorganizational bargaining" which functions to achieve consensus within each of the inter-acting groups;
- (4) "attitudinal structuring" which refers to those activities which influence the attitudes of the participants towards each other.

This four-way breakdown is indeed a very useful way of looking at labour negotiations as one of the mechanisms for converting the inputs into outputs. It also has significant practical import for those concerned with the various forms of continuous bargaining.

In addition to the basic collective bargaining process between labour and management, there are various forms of third party assistance which may be used as mechanisms for converting the inputs into outputs. In Canada, for example, we have the two-stage compulsory conciliation process in many of our political jurisdictions. I am sure that most, if not all of you in this audience, are familiar with the criticisms of this process. In some jurisdictions, this two-stage process is now giving way to a one-stage process in which the emphasis is placed on effective mediation. Finally, there is the process of compulsory arbitration. Since much has been said about this process during the past year, I will do no more than make

reference to it here - which I must do as a social scientist who is interested in the various types of mechanisms for converting inputs into outputs.

If the various mechanisms mentioned above fail to convert the inputs into outputs, then the outputs are usually achieved as the result of a trial of strength. This may take the form of a strike by the workers or a lockout on the part of management. Eventually, however, one or more of the mechanisms mentioned above must be utilized during a strike or lockout in order to get the workers back on the job and to get an agreement with conditions which are satisfactory to them and to management. When a strike does result, however, it is important to recognize that this is an output of the industrial relations system and that it may have serious consequences for the other environmental sub-systems as well as the industrial relations system itself. I will have more to say about this when I discuss the concept of the feedback loop.

Thus far, I have been speaking about the institutional or organizational mechanisms for converting inputs into outputs. However, I wish to point out that industrial relations consists not only of periodic negotiations - although these unfortunately seem to pre-occupy our attention - but also of the day-to-day relationships among individuals at the work level. These constitute a complicated set of relationships involving those between managers, workers and managers, workers themselves, and workers and their union representatives. To a large extent, it is at this level that the participants satisfy their social and psychological needs. I should point out also that many of the individual and group needs are satisfied more through the

informal structures which emerge rather than through the formal structures. And, as numerous studies of bureaucracy show, not only individual and group needs but also organizational needs are often best met through the informal structures.

The Outputs of Industrial Relations Systems

Let me now look briefly at the outputs of industrial relations systems. As stated at the beginning of this paper, the main function of an industrial relations system is the allocation of rewards to employees for their services. Among the many types of substantive outputs of an industrial relations system, I would include wages, hours of work, statutory holidays, vacations with pay provisions, technological change provisions, training programs, pension plans, supplemental unemployment benefits, hospital and medical plans and the other types of fringe benefits which employees receive, as well as seniority provisions which determine, to some extent, who remains employed or gets promoted and consequently who receives rewards. Industrial relations research is concerned not only with changes in the level of rewards from one period to another, but also with the levels of rewards themselves. In order to provide a good understanding of the national industrial relations systems, one must make also comparisons as among different industries and regions. Furthermore, when one examines the substantive outputs of an industrial relations system, one must also be

concerned not only with the amount or rate of change in any one provision, but also with the emphasis that is placed on the different types of substantive outputs - i.e. the trade-off among the outputs. For example, during periods of high unemployment or rapid technological change, one will probably find a great deal of emphasis on various job and income security provisions, whereas during periods of high employment one will probably find a greater degree of emphasis on wages and more immediate and direct forms of benefits. The paper that I was to have presented today would have dealt predominantly with these types of subject matter. However, I do hope to complete a monograph during the summer covering these and other subjects for the period 1953 to 1966.

I should like to re-emphasize that the discipline of industrial relations must be concerned not only with the substantive or material rewards for employment, but also with the types of social relationships and rewards that exist between management and labour at any level of an industrial relations system, ranging from the national system down to the lowest unit of a plant. These social relationships and rewards are often as critical in determining the degree of satisfaction which employees derive from employment as are the financial or material types of rewards. (7)

Thus far I have been discussing the outputs of an industrial relations system in terms of rewards to employees for their services. However, I do not wish to leave the impression that one should look at the outputs of an industrial relations

system solely in these terms. One must also look at the outputs in terms of their effect on the other sub-systems of society. Hence, it is necessary that we have a feedback loop linking the industrial relations system to the environmental sub-systems within which an industrial relations system functions. It is to this that we now turn.

The Concepts of the Feedback Loop

The feedback loop may be conceived of, then, as the linkage between the outputs of the industrial relations system and the environmental sub-systems within which the industrial relations system operates. Conceptually, then, the outputs of the industrial relations system become inputs into the environmental sub-systems, and subsequently through their effects on the environmental sub-systems flow back into the industrial relations system as part of the conditioning inputs. I should also point out that the outputs of an industrial relations system feed back directly into the industrial relations system itself without any intermediary linkages. This is true, for example, where satisfactory wages and fringe benefits plus pleasant working conditions have a very beneficial effect on the morale of employees in a work environment.

There are a number of reasons why the emerging discipline of industrial relations must be concerned with the feedback loop which is part of our model. First, from a

scientific point of view, it is necessary to look at the feedback in order to see how the outputs of the industrial relations system feed back into the environmental sub-systems and through their effect of these systems subsequently come back to the industrial relations system in the form of conditional inputs. This establishes a scientific basis for including the concept of the feedback loop. Secondly, from a public policy point of view, it is essential that we investigate the consequences of the outputs of the industrial relations system for the other sub-systems of society. For example, what is the impact of strikes on the economic system, the legal system, the political system and the social system? What is the impact of wage and related changes on costs, prices, and employment? How do the outputs of the industrial relations systems affect community attitudes to both labour and management? While it may be difficult to establish objective measures with which to assess the impact of these outputs, it is nevertheless incumbent on scholars interested in the discipline of industrial relations to develop measures which will enable us to ultimately assess what impact the outputs have.

Concluding Comments

With this discussion of the feedback loop, I have now come full circle since I am back to the environmental inputs again. I would like to make but one concluding comment. As

you are well aware by now, I have made no substantive contribution to our knowledge of industrial relations today. This was not my purpose. My objective was to set forth, in a rudimentary way, a conceptual model which will help us better organize the knowledge we already possess and, more importantly, a model which should enable us to advance from the descriptive to the analytical or explanatory stage in the development of the emerging discipline in which many of us are engaged. I do not look upon the model which I have presented here today as the ideal model, nor do I expect all of you to agree with the approach suggested here. However, if my comments serve to stimulate thinking in an area which has been largely ignored by industrial relations scholars, then society, industrial relations practitioners, our emerging discipline and those of us who take it seriously will be the beneficiaries.

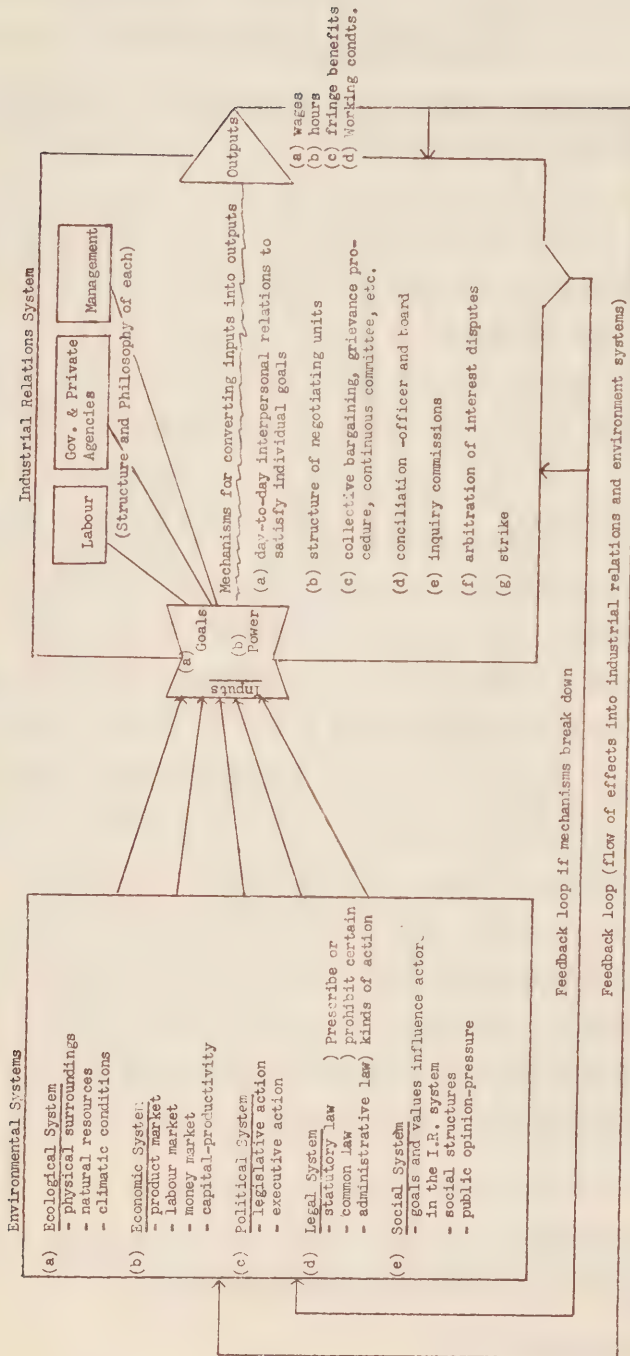
Thank you.

Footnotes

1. See David Easton, A Framework for Political Analysis (Englewood Cliffs, N.J. Prentice-Hall, Inc., 1965), and A Systems Analysis of Political Life (New York: John Wiley & Sons, Inc., 1965).
2. See Otto Eckstein and Thomas A. Wilson, "The Determination of Money Wages in American Industry", Quarterly Journal of Economics, Vol. LXXBII, No. 3, August 1962, pp.379-414.
3. For a brief discussion of the goal and value patterns in Canadian society, see John Porter, "Canadian Character in the Twentieth Century", The Annals of the American Academy of Political and Social Science, Vol. 370, March 1967, pp.48-56.
4. See Syed M.A. Hameed, "Theory and Research in the Field of Industrial Relations", in the forthcoming July 1967 issue of the British Journal of Industrial Relations.
5. See Carl M. Stevens, Strategy and Collective Bargaining Negotiation (New York: McGraw-Hill, 1963).
6. See R.E. Walton and R.B. McKersie, A Behavioral Theory of Labor Negotiations (New York: McGraw-Hill, 1965).
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Restricted

A Framework for Analyzing Industrial Relations Systems
(A Structural-Functional Approach)



WAGES AND COSTS IN CANADIAN INDUSTRY

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Labor Statistics, June 1964, Miami Beach, Florida)

Some global statistics 2/ on wages, prices, and output trends in Canada since 1949 have just been distributed to you (see table 1). I should like to say a few words about these statistics before describing some of the Canadian Department of Labour's work on the wage-price relation.

You will note that the price indexes in lines 4, 5, and 6, table 1, show a great deal of change between 1949 and 1953. This is to be expected in the light of economic conditions at that time. Canada was in the midst of the boom conditions of the postwar and Korean war periods and this boom was reflected in rapid rises in prices, wages, and output.

Since 1953, price increases have been much more modest. However, the degree of price stability achieved is unclear from table 1. The Wholesale Price Index increased by less than 9 per cent between 1953 and 1962 and the Consumer Price Index increased by about 13 per cent in the same period. The Gross National Product (GNP) Implicit Price Index, on the other hand, increased by almost 20 per cent over this period, a much higher rate of increase than that

*/ The author expresses his thanks to Messrs. John Millons and Winston Chambers for their help.

2/ See pages 22-24.

indicated by either the Wholesale Price Index or the Consumer Price Index. The faster rate of increase in the GNP Implicit Price Index may be attributed to the rapid rise in the price of investment goods between 1955 and 1957 and, to some extent, to the shifts in the components of GNP between 1953 and 1957. This is reflected in table 1, for 1953-1957. In that period the GNP Implicit Price Index rose at a considerably faster rate than either the Consumer Price Index or the Wholesale Price Index. Since 1957, the three price indexes show considerably more consistency in behaviour. On the whole, price increases between 1957 and 1962 were not unusually large.

Wage increases since 1953 have been quite substantial, amounting to some 40 per cent between 1953 and 1962. This represents a much higher rate of increase than the price advances that have occurred during that period. The implication is that wages have been outstripping productivity with some resulting pressure on prices. Since official productivity statistics are not yet available for Canada, it is difficult to know precisely what the wage-productivity-price relation was in the period 1953 to 1962.

It is noteworthy that the gains in real incomes made by workers since 1953 do not appear to have been at the expense of other income earners. I make this statement even though the statistics in line 16 of table 1 show a sharp jump in the labour share of the national income between 1953 and 1957. This share increased from 62.8 per cent in 1953 to

66.7 per cent in 1957, an increase of 6 per cent. This shift has been attributed mainly to a sudden decline in agriculture's share (which has a very low ratio of wages to total income); continuation of the long-term decline in nonfarm unincorporated business; and a relative employment increase in the Government and services industries (which have a very high ratio of wages to total income). Between 1957 and 1962, however, the labour share showed remarkable stability.

These statistics give only an overall view of wage and price movements in the Canadian economy from 1949 to 1962. As such, they may make interesting comparisons with similar global series in other countries, which I believe will be presented in other papers during this session. The statistics, however, do not indicate the manner in which wages and prices are related, for three main reasons.

First, the various series are not comparable, because they have been developed, collected, and tabulated for different purposes. Thus, it would be difficult to interpret intelligently and with any degree of certainty the ways in which the changes in various series are related. For example, wages and prices are related in certain ways, but because the two series, as recorded in table 1, were derived differently, it would not be possible to say very much about their relation. Movements in one series may be totally

unrelated to movements in the other.

Second, during the past decade in Canada, major changes have taken place in the structure of employment and industry. Since such changes become incorporated in the gross statistical aggregates, it is not possible to identify how much of the changes in the statistical aggregates reflect shifts in employment, capital, and other resources and how much reflect actual changes in the variable factors (that is, changes in prices and wage rates).

Third, simple aggregates of statistical data on the Canadian economy cannot be properly analyzed because these aggregates obscure the highly segmented nature of the economy and thereby obscure the nature of the changes taking place in the economy. Canada is characterized by a high degree of regional and industrial specialization, such that the different regions and industrial sectors behave virtually like independent economic units. Each sector has its own particular problems and aspirations and each sector experiences a different level of economic development and economic prosperity. This characteristic of the Canadian economy derives from five main factors: (1) The dispersed settlement of a small diverse population on the world's second largest land area (some 90 per cent of the 19 million Canadians live within 50 miles of the United States border, along an area that stretches 4,000 miles from the Atlantic to the Pacific); (2) the uneven and unequal distribution of resources; (3) the political structure (some 90 per cent of employment comes

under the jurisdiction of 10 separate provincial governments); (4) the high cost of east-west communication which is associated with the much cheaper north-south pull of the neighboring United States; (5) and the importance of international trade. In other words, Canada is a highly heterogeneous country lacking uniformity of behaviour and experiencing only a minimal development of national economic patterns.

Even if aggregate statistics of wages, prices, and output could be adjusted to overcome these three major difficulties, they would still not have too much relevance in the Canadian setting since these statistics shed little light on Canada's major problem, namely her international competitive status. If you consider that Canada's export sector accounts for some 25 per cent of GNP, and that imports are equivalent to more than one-fifth of the national product, or that almost 50 per cent of Canada's total production is affected by international trade, you will quickly appreciate the importance of Canada's international sector to the Canadian economy. The simple fact is that the economic performance of the Canadian economy is a function of the performance of her industries that are engaged in international trade. There is a need, therefore, to supplement the usual gross statistical aggregates with statistics related specifically to the industrial sectors exposed to the international economy. Only then shall we be

in a position to make assertions about the overall performance and competitive status of the Canadian economy.

To this end, we in the Canadian Department of Labour are engaged in the development of a series of data that will enable us to see more clearly the relation between recent wage trends on the one hand, and costs of production and the competitive position of the Canadian economy on the other. I should like to spend the remainder of the time allotted to me to describe this work on wages and costs in the international trade sector of the Canadian economy. The study is still in a preliminary stage and I shall be able to report on it in only a general way.

The first part of the study encompasses an investigation of a series of wage, productivity, and cost data for 22 "import-competing", "export" and "domestic" manufacturing industries. The industries were chosen on the basis of their importance in the manufacturing sector and the availability of data necessary for the analysis. In 1958, these 22 industries accounted for the production of \$12.7 billion worth of goods or 57 per cent of the value of all manufacturing output in that year.

There are no published data in Canada for industries classified into the three trade categories: Import-competing, export, or domestic. We therefore developed our own classification for the study. The method followed was first to allocate import and export items which are listed either in the Trade of Canada statistics or in annual industry

census reports to their appropriate industries; and second, to take the value of these import (and export) items (1) as a per cent of the market (i.e., the selling value of factory shipments plus imports minus exports) to determine the degree of import competition, and (2) as a per cent of the selling value of factory shipments to obtain the degree of exports. In allocating trade commodities by industry, it was not possible to distinguish between imported products which actually compete with the output of Canadian industries and imported products for which there is little Canadian production. Thus, some of the industries studied, such as machinery manufacturing, might better be described as import-sharing rather than import-competing.

The list of the 22 industries and their trade classification are shown in table 2. It may be of interest to note that the U.S. counterparts of seven of the industries in the import-competing sector, that is iron castings, primary iron and steel, machinery, clothing, cotton goods, motor vehicles, and motor vehicle parts, are responsible for more than 50 per cent of U.S. commodity exports to Canada. (Because of this fact we have begun a comparative study of these seven industries in the United States and Canada.)

The 11 industries included in the import-competing sector sell a major portion of their output on the domestic market. Only a fraction of the output of these industries

(less than 10 per cent of the selling value of factory shipments in 1959) is exported. In 1958, some 34 per cent of all imports into Canada were imports which competed or shared the market with the production of these 11 industries.

The five industries classified as export industries exported a large proportion of their output (between 35 and 75 per cent of the selling value of factory shipments in 1959) and faced relatively minor competition from imports. About 43 per cent of all Canadian exports in 1958 came from these five industries.

In the six domestic industries, exports and imports were both relatively small and production was primarily for the domestic market.

The range of data collected for the analysis of the wage-cost relations in these industries is indicated by the stub of table 3. Separate measures are included of the wages of non-office, or production, workers and salaries of white-collar workers and of the costs per unit of physical output attributed to wages, salaries, raw materials, fuel and electricity, and non-labour inputs (e.g., profits, capital depreciation, interest, and rent). These costs when added together give the total cost per unit of physical output, or the factory price. Table 3 also includes employment data for production and white-collar workers and productivity as measured by output per production worker and output per production worker man-hour. Table 3 does not display all the data that have been analyzed in this study. Information has

also been tabulated on occupational straight-time wage rates by industry, profits, and capital cost allowances. These data are being incorporated into a second part of the study which is now being worked on in the Canadian Department of Labour. All of the data included in table 3 are available in or derived from publications of the Dominion Bureau of Statistics; most of the data are from the Bureau's annual reports of census of industry.

The data for the variables listed in table 3 have been indexed on a 1953 base and show changes between 1953 and 1959. The year 1959 is the terminal year for the main part of the analysis, since the Dominion Bureau of Statistics made a major change in the Standard Industrial Classification in 1960 and there was no time for this paper to reconcile the changes in the industrial classification. In any event, 1960 is the latest year for the industry census information which is the basic source of the material for this study. Information on the variables described is usually published 3 or more years after the date to which it refers. To obtain some notion of developments since 1959, however, we updated the data in this study to 1962 on the basis of other information. The results of the updating are discussed briefly at the end of this paper.

Before proceeding to the findings of the study, I have three additional comments to make about the data. The first concerns the information on wages and salaries. It should be emphasized that these data refer to wages and

salaries alone. Expenditures on fringe benefits are excluded because comprehensive data on employer expenditures for fringe benefits are not yet available for Canada. Clearly, given our knowledge of the increasing incidence of fringe benefits since 1953, there is probably an increasing underestimation of the unit costs or production attributable to labour costs.

The second point about the data concerns the labour element in a number of the production inputs, such as raw materials. The labour costs included in these raw materials inputs no doubt have had an effect on production costs in the manufacturing industries surveyed. It has not been possible to separate the influence of this raw materials labour cost factor in the analysis. However, this does not affect the validity of the findings of the project at hand, since the study is concerned with the relation between costs and the direct payment to labour.

Thirdly, "wages" in this paper refer to pay for all production and related hourly rated workers. "Salaries" refer to pay for administrative and office employees including all executive and supervisory personnel, managerial, professional and technical employees, foremen, and clerical employees. The wage data used to derive unit wage cost figures refer to all production and related workers whether paid on a monthly, weekly, hourly, or piecework basis. The various unit cost, employment, and productivity data are based on information received from all establishments in the

industries surveyed. The average hourly earnings and average weekly salaries information is based on data from establishments employing 15 or more employees.

So much for the methodology and nature of the data. To put the study into perspective, I should like to comment briefly on the changing economic fortunes of the three categories of industries during the 1950's. Eight of the import-competing industries underwent a significant adverse change in the period from 1953 to 1959, when compared with the economy as a whole. Before 1953, there had been a long period of continuously rising physical output in these eight industries. Between 1953 and 1959, output in 5 of the 8 declined. After 1956, output in seven of these industries declined and output in 1 of the 8 barely increased. From 1953 to 1959, the degree of import competition increased in all eight industries. By contrast, the remaining 3 of the 11 import-competing industries; namely, iron castings, primary iron and steel, and synthetic textiles, did well during the period from 1953 to 1959; these three industries experienced rapid increases in output and declining import competition.

The fortunes of the five export industries tended to worsen during the period from 1953 to 1959, but the degree of worsening in the export industries was not nearly as great as it was in the import-competing industries. Physical output increased in all five of the export industries, although in three of them the rate of increase was less than

that of manufacturing industries as a whole. During the latter part of the period 1953 to 1959, export markets began to decline for 4 of the 5 industries.

In contrast to the fortunes of the export and import-competing industries, the six domestic industries experienced continuing prosperity between 1953 and 1959.

The most significant finding of the study to date is that wage pressures have had a decidedly minor direct upward impact on factory prices in most of the 22 industries under review, despite rather large increases in average hourly earnings. During the 1953-59 period, average hourly earnings increases in most of the industries ranged between 25 and 35 per cent. Several industries experienced increases in average hourly earnings of less than 20 per cent and several had increases of more than 35 per cent. The import-competing industries tended to experience smaller increases in wages than did the export and domestic industries. The largest increases in average hourly earnings occurred in the domestic industries.

In translating these wage advances into wage costs per unit of physical output, we found that in 9 industries out of the 22 studied, (7 of them in the hard-pressed import-competing sector) unit wage costs actually declined between 1953 and 1959. In two of the import-competing industries the declines amounted to some 23 per cent and 26 per cent below 1953 levels. In none of the remaining four import-competing industries did the increase in unit wage costs over

the period 1953 to 1959 amount to more than 10 per cent. Unit wage cost behaviour in the export and domestic industries was, on the whole, less favourable than in the import-competing industries. Nevertheless, increases in unit wage costs between 1953 and 1959 in most export and domestic industries were well below the increases in average hourly earnings in these industries.

Factory prices or total costs per unit of physical output rose in all but 4 of the 22 industries during the period under review. The major source of the price advance was found to be the costs of employing inputs other than production labour, e.g., raw materials, in the production process. Rapid increases occurred in the costs of employing salaried workers and in the costs of raw materials and non-labour inputs. For example by 1959, four industries (three in the import-competing sector) experienced rises in salary costs per unit of output ranging between 48 per cent and 70 per cent above 1953 levels. In a similar manner four industries, all import-competing, saw increases in their non-labour unit costs (mainly profits and capital costs allowances) range from 47 per cent to 74 per cent above 1953 levels.

When we bring together these trends in the costs of the various production inputs, we find that unit wage costs actually had a negative effect on total costs in 7 of the 11 import-competing industries in the 1953-59 period.

In other words, increases in the total costs of production in most of the import-competing industries have been due largely to the advances in the costs of inputs other than production labour. The costs of production labour served to dampen the magnitude of the rise in total costs or factory prices. In the export and domestic industries, unit wage costs did exert some upward pressure on total costs, but the pressure was much less than the effect of cost increases due to white-collar worker employment, raw materials, and the wide range of non-labour inputs (mainly capital and profits).

In other words, the preliminary statistics which have been brought together in this study reveal that a fundamental change appears to be taking place in the input and cost structure of Canadian industry and that this change has been accelerated in the sectors exposed to international competition. Greater numbers of non-production workers are being employed in these industries and greater use is being made of machinery. For example, non-production or salaried employment was higher in 1959 than in 1953 in 18 of the 22 industries surveyed. Gains in salaried employment were in many instances substantial, ranging up to 20 or more per cent in some industries as compared with 12 per cent in all manufacturing.

On the other hand, the numbers of production workers in the 22 industries did not increase by nearly the same rate as did salaried workers. In fact, in all of the 11 import-competing industries, 3 of the 5 export industries and 1 of the 6 domestic industries, the number of production workers in 1959 was below the number in 1953. These declines have taken place despite some very large increases in output. In two import-competing industries, for example, output in 1959 was 42 per cent and 67 per cent above 1953. Fewer production workers are being used to produce an ever-expanding output in most of the 22 industries.

These changes in the production process of the 22 industries are reflected in the very large increases in productivity as measured by either output per production worker or output per production-worker man-hour. Such increases tend to be much greater in the import-competing industries than in the export and domestic sectors. For example, in two of the import-competing industries, productivity (output per man-hour) in 1959 was two-thirds or more above 1953 levels compared with an estimated output per man-hour increase of about 25 per cent in all manufacturing during the same period. Even in import-competing industries where output declined between 1953 and 1959, productivity advances have been substantial. In two of these industries, output per man-hour rose some 30 per cent between 1953 and 1959 despite declines in physical output

of 3 per cent and 5 per cent, respectively.

Adjustments of this magnitude doubtless reflect the rapid advances in new technology which are taking place in Canadian industry today. This interpretation of developments in many of the 22 industries, and particularly in the import-competing industries, is consistent with evidence available elsewhere and the additional work we have been doing on the 22 industries. The employment of greater numbers of highly trained people follows the development of more efficient machinery and more sophisticated techniques of production. This, in turn, has resulted in fundamental changes in the relative weights of wages, salaries, capital, and other input costs in total costs of production; and, hence, in fundamental changes in the price determination process. The simple wage-price relations so often assumed in current analysis can no longer be accepted as valid in Canadian industries which are subjected to rapid economic change. The findings of this study demonstrate the complexity of the price determination process and the complex ways in which wages are related to prices. A basis understanding of the wage-price relation will not come until we have probed more deeply into the problem than has been the case to date. The research described here is a first step in this direction.

I should like now to touch briefly on trends in costs and prices in the 22 industries since 1959. This trend analysis is based on a crude updating of the information used in the study for the period 1953-59. The information used to update the variables since 1959 comes from sources other than those used for the analysis of the variables in the 1953-59 period. Preliminary results of the trend analysis show some interesting movements between 1959 and 1962. The output performance of many of the import-competing industries since 1959 was not as unfavourable as it was during the 1953-59 period. Wage increases continued to have little direct upward impact on total costs (or factory prices). Although unit wage costs showed a greater propensity to rise after 1959 than they did in the previous period, unit total costs did not rise as much and, in fact, actually declined in five of the import-competing industries.

Greater adjustments are noted in the export industries; these adjustments reflect increasing export competition. Similar adjustments appear to have begun in the domestic industries. In both of these categories of industries, output performance is below that of the previous period and average hourly earnings, unit wage costs, and unit total costs do not appear to be rising at the same rate as in the 1953-59 period.

In summary, the changes in the 22 industries since 1959 have not been sufficiently large to make a great

deal of difference between the cost-price trends for the 1953-59 period and the cost-price trends for the 1953-62 period.

Data on other variables such as raw materials, salaried workers, and non-labour inputs were not available for the purposes of updating. Clearly therefore the updating technique was cruder than we would have preferred.

Finally, then based on the preliminary statistics which have been developed in the Canadian Department of Labour, we can say that recent wage trends in Canada have not pushed up costs or prices to any international competition. Productivity advances, reflecting the fundamental adjustments that appear to be taking place in these industries, have been, on the whole, sufficient to offset cost pressures resulting from continuing rising wage levels. Price increases have been due to increasing expenditures on other inputs in the production process or to pressures of demand.

These findings would have been masked had the analysis been conducted at the aggregative level of analysis. In earlier studies in Canada on the relationship of wages to prices and on Canada's competitive position, global approaches to wage-price behaviour have tended to lead to different conclusions from those of this study. Table 3 provides an illustration of the potentially

different findings that can emerge about these questions as a result of different approaches. The individual 22 industries and all manufacturing are analyzed according to the variables used in this study. It can be seen that the deviations from all manufacturing of the 22 industries are quite marked in a large number of cases. I have alluded to the magnitude of some of these deviations during the course of the paper. The statistics suggest that the behaviour of these variables in all manufacturing does not indicate their range of behaviour in individual manufacturing industries. More specifically, all manufacturing is not necessarily a good indicator of the important industries exposed to international competition. More aggregative statistics than all manufacturing would be even less reliable as indicators of economic performance and behaviour in the international industries.

Moreover, global approaches to wage-price problems often fail to grasp the underlying complexities of the price determination process and the ways in which wages are related to prices. These complexities emerge in investigations which are made at less aggregative levels. The study I have described has shown that wage-price behaviour is not as simple as it is often assumed to be. Changes in one variable (for example, wage rates) do not necessarily lead to the same kind of changes in the price variable. The manner in which the

two variables are related depends on a wide variety of factors including the ways in which the various inputs in the production process are combined.

There is no doubt that in Canada global statistics offer a good starting point for a generalized view of wage-price behaviour. But where policy considerations are involved or where there is need for more basic information on wage-price relations, a more searching approach is required. In Canada in recent years this has meant a need for investigations of wage-price behaviour in industries exposed to international competition because Canada's ability to compete is vital to the overall performance of the economy. The work we are doing in the Canadian Department of Labour, which I have described to you in part today, is an attempt to provide this kind of investigation and to determine how wage-price behaviour is affecting the efficiency of Canadian industry in international trade.

Table 1. Percent Change in Wages, Prices,
Output, and Other Economic Indicators,
Canada, Selected Periods, 1949-62

Item	1949-53	1949-62	1953-57	1957-62	1953-62
1. Wage rates (production worker):					
All industry.....	33.6	85.9	17.1	18.8	39.1
Manufacturing.....	34.6	84.5	17.8	16.3	37.1
2. Average hourly earnings of hourly rated wage earners					
Manufacturing.....	37.8	90.2	17.9	17.0	38.0
3. Average weekly wages and salaries:					
Industrial composite.....	33.9	87.6	18.1	18.7	40.1
Manufacturing.....	34.8	89.2	18.0	18.9	40.4
4. Consumer Price Index.....	15.5	30.7	5.5	7.2	13.2
5. Wholesale Price Index.....	11.3	21.0	3.0	5.5	8.7
6. Gross National Product Implicit Price Index.....	20.2	43.7	10.0	8.6	19.5
7. Corporation profits.....	46.9	108.3	9.2	29.9	41.8
8. Gross national product (current dollars).....	53.1	147.2	27.5	26.6	61.5
9. Gross national product (constant 1957 dollars).....	27.3	72.0	15.9	16.6	35.1
10. Gross domestic product:					
Total economy.....	49.2	141.4	28.1	26.3	61.8
Nonagriculture.....	51.7	155.6	33.5	26.2	68.4
Manufacturing.....	50.0	177.8	22.5	18.5	45.2
11. Real gross domestic product:					
Total economy.....	26.7	71.4	16.0	16.6	35.3
Nonagriculture.....	25.5	75.8	19.9	16.8	40.1
Manufacturing.....	26.4	64.9	13.1	15.4	30.5
12. Labour force (employed):					
Total economy.....	6.6	26.5	9.4	8.6	18.8
Nonagriculture.....	14.1	45.0	13.8	11.7	27.1
Manufacturing.....	6.2	20.3	7.8	5.0	13.2
13. Domestic exports:					
Current dollars.....	37.6	106.4	16.3	29.0	50.1
Volume.....	20.1	67.7	14.4	22.1	39.6
Price index.....	14.5	24.0	2.3	5.9	8.3
14. Imports:					
Current dollars.....	56.5	130.6	28.9	14.3	47.3
Volume.....	46.1	89.2	21.1	6.9	29.5
Price index.....	6.6	21.3	6.4	7.0	13.8

	1949	1953	1957	1962
15. Exchange rate (Can. \$1 U.S. \$1 in 1950).....	108.92	98.34	95.88	106.89
16. Labour's share of net national income (percent).....	62.0	62.8	66.7	66.5
17. Current account balance of payments (millions of dollars).....	✓187	-443	-1,455	-848

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Sources:

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12. The Labour Force. Special Surveys Division, Dominion Bureau of Statistics.
- 13, 14. Foreign Trade. International Trade Division, Dominion Bureau of Statistics.
15. Statistical Summary. Bank of Canada
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Table 2. Classification of Industries as Import-Competing, Export, or Domestic

Group I

Import-Competing Industries

Iron castings
Synthetic textiles
Primary iron and steel
Rubber goods, including footwear
Electrical apparatus and supplies
Machinery
Clothing
Cotton goods
Woollen goods
Motor vehicles
Motor vehicle parts

Group II

Export Industries

Distilled liquors
Pulp and paper
Nonferrous smelting and refining
Brass and copper products
Saw and planing mills

Group III

Domestic Industries

Petroleum products
Tobacco and products
Slaughtering and meat packing
Sheet metal products
Breweries
Furniture

Table 3. Relationship of Changes in Wages, Costs, Employment, and Production in 22 Import-Competing, Export, and Domestic Manufacturing Industries to All Manufacturing Average, 1953-59

Variables Studied	Import-competing		Export		Domestic	
	Number of Industries--					
	Above manufac- turing	Below manufac- turing	Above manufac- turing	Below manufac- turing	Above manufac- turing	Below manufac- turing
Average hourly earnings.....	3 (1)	7 (3)	3 (1)	1	4 (3)	2
Average weekly salaries.....	2	8 (3)	1	3 (1)	2 (2)	3 (1)
Industrial production.....	6 (3)	5 (5)	2	3	4 (4)	2
Production worker employment	2	8 (4)	2 (2)	2	5 (5)	1
White-collar worker employment.....	7 (1)	4 (3)	4 (2)	1 (1)	5 (2)	1
Total employment.....	3	8 (4)	3 (2)	2 (1)	5 (5)	1
Output per production worker	8 (3)	3 (1)	1 (1)	4 (2)	3 (2)	3 (1)
Output per production worker man-hour.....	8 (3)	3 (1)	-	4	3 (2)	3 (2)
Output per all workers.....	7 (4)	4 (2)	2	3 (2)	2 (2)	3 (1)
Unit total costs.....	5 (2)	6 (3)	1 (1)	3	2 (2)	4 (1)
Unit wage and salary costs..	3 (2)	7 (3)	4 (1)	1	4 (1)	2 (1)
Unit wage costs.....	3	8 (4)	4 (1)	-	4 (3)	2 (1)
Unit salary costs.....	3 (3)	6 (4)	2 (1)	3	3	3 (2)
Unit raw material costs.....	7 (1)	4 (2)	1 (1)	4 (1)	2 (2)	4 (2)
Unit nonlabour costs.....	6 (5)	5 (3)	3	2 (2)	3 (1)	3 (1)
Unit fuel and electricity costs.....	5 (1)	5 (5)	2 (1)	3 (2)	2 (1)	4 (2)
Unit net total costs.....	7 (2)	4 (3)	3 (1)	2 (1)	3 (1)	3

Note: Totals in each line do not necessarily equal 22 because in some cases changes are equal to the changes in manufacturing or because data are not available.

Figures in parentheses show for each variable, except average hourly earnings and average weekly salaries, the number of industries in which the relation between the individual industry and all manufacturing changed by 10 or more percent during the period 1953-59. In the case of average hourly earnings and average weekly salaries, the figures in parentheses indicate a change in the relation amounting to 5 or more percent.

Method of Calculation of Index Numbers

Since index numbers of average wage rates were first published in 1921, improvements have been made in the quality of the primary data, in the extent of industrial and occupational coverage, and in certain of the methods of calculating index numbers. While improvements in the quality and scope of wage rate statistics have been made regularly, major revisions in the index numbers have been introduced infrequently and only when there was a change in the base period.

In 1966, in order to make the index numbers of average wage rates comparable with indexes being produced in other government agencies, it was decided to change the base year from 1949 to 1961. Along with this change, the weights used in calculating the index numbers have been revised to reflect more recent conditions than the weights used previously.

The adoption of the 1960 Standard Industrial Classification caused changes in the occupational make-up of some industries and led to the appearance of entirely new industries for which a series of wage rate data permitting the calculation of index numbers will not be available for some years. Index numbers will be prepared for the years 1961-65 that incorporate all these changes for all industries for which sufficient data are available. This will enable users to compare the effects of the changes on these

industries for which 1961-65 indexes on the old basis have already been published using 1949 as base year.

The industry index numbers are derived from occupational indexes of wage rates. These are calculated on the base of average wage rates in 1961 as 100, using a system of "aggregates of weighted averages". The rates for time work and incentive earnings are combined in the calculation of the occupational index numbers.

The index numbers are based on the rates paid to certain non-office occupations in which, during the period 1963-65, a significant proportion (2 per cent or more) of all non-office employees were reported. The movement of rates for these occupations is considered to reflect changes in rates paid for all non-office occupations in the industry.

Average wage rates are calculated for each of these selected occupations within the industry for each of five regions in Canada - Atlantic Provinces, Quebec, Ontario, the Prairie Provinces and British Columbia. However, if any region contained less than 2 per cent of the industry's non-office employment, as reported to the survey over the period 1963-65, no average is calculated for that region. For each occupation, the regional average wage rate is multiplied by a percentage (weight) which is the proportion of the industry's total non-office employment found in this region over the period 1963-65. The proportion or weight for a region is held constant from year to year in order to isolate the movement of wage rates for an occupation from the

effects of inter-regional employment shifts. The index number for the occupation is obtained by dividing the sum of the products of average rates and region weights by a similar aggregate for the base year, 1961.

These occupational indexes are then multiplied by their appropriate occupational weights, and the aggregate, divided by the sum of the weights is the index number for the industry. Each occupational weight represents the proportion of the number of employees in that occupation to the total number of employees in all the occupations used in the calculation of the index number, as reported over the period 1963-65. These weights are also held constant from year to year.

To obtain an index number for a major group such as Food and Beverage Industries or Textile Industries, industry indexes are weighted on the basis of labour force data from the 1961 Census so as to reflect the relative importance of each industry. Index numbers for industrial divisions such as Mining, Manufacturing, etc., are obtained by weighting the major group indexes using weights based on 1961 labour force data for each major group.



First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

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PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

The Honourable DONALD CAMERON, *Vice-Chairman*

No. 28

WEDNESDAY, FEBRUARY 12th, 1969

WITNESSES:

Department of Manpower and Immigration: Dr. W. R. Dymond, Assistant Deputy Minister, Program Development; Dr. Duncan R. Campbell, Acting Director, Planning and Evaluation Branch; Harry H. Morritt, Assistant Director, Manpower Information and Analysis Branch; and K. V. Pankhurst, Chief, Manpower Requirements Section.

APPENDIX:

29.—Brief submitted by the Department of Manpower and Immigration.

THE QUEEN'S PRINTER, OTTAWA, 1969

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Grosart	Nichol
Belisle	Haig	O'Leary (<i>Carleton</i>)
Blois	Hays	Phillips (<i>Prince</i>)
Bourget	Kinnear	Robichaud
Cameron	Lamontagne	Sullivan
Carter	Lang	Thompson
Desruisseaux	Leonard	Yuzyk
Giguère	McGrand	

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,
The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,
The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

Wednesday, February 12th, 1969

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Bourget, Cameron, Carter, Grosart, Haig, Kinnear, McGrand, Robichaud, Sullivan, Thompson and Yuzyk—12.

In attendance:

Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

DEPARTMENT OF MANPOWER AND IMMIGRATION

Dr. W. R. Dymond, Assistant Deputy Minister, Program Development;

K. V. Pankhurst, Chief, Manpower Requirements Section;

Dr. Duncan R. Campbell, Acting Director, Planning and Evaluation Branch; and

Harry H. Morritt, Assistant Director, Manpower Information and Analysis Branch.

In attendance:

Robert Lachapelle, Acting Director of the Research Branch.

(A curriculum vitae of each witness follows these Minutes.)

The following is printed as Appendix No. 29.

—Brief submitted by the Department of Manpower and Immigration.

At 1.00 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

DYMOND W. R., William Richard Dymond was born in Toronto, and received his secondary school education at Upper Canada College, Toronto. Dr. Dymond holds a Master of Arts degree in Economics from the University of Toronto and a Doctor of Philosophy degree, also in Economics, from Cornell University. His graduate thesis was in the field of studies of labour-management committees and the way in which they operated in the United States and Canada. He entered the service of the Department of Labour in the Economics and Research Branch in 1951, having previously been professor of economics at the University of Massachusetts. Shortly after his entry into the service, he was appointed Chief of the Manpower Division of the Economics and Research Branch; on January 1, 1957 he became Director of the Branch; and on September 18, 1961 was appointed Assistant Deputy Minister of the Department. Dr. Dymond has been a sessional lecturer in labour economics at Carleton University, Ottawa. He has also lectured in this subject at McGill University, Montreal, and was a staff member of a management seminar held at the University of Southern California in the summer of 1958. Dr. Dymond has represented Canada at meetings of the International Conference of Labour Statisticians and has delivered papers at sessions of the American Economic Association, the American Statistician Association, and the Canadian Political Science Association. He was a member of a special Interdepartmental Committee on Unemployment Statistics and has represented the Department of Labour in many discussions with governmental and non-governmental agencies interested in labour relations and manpower. In 1965 he was elected Chairman of the Manpower and Social Affairs Committee of the Organization for Economic Co-operation and Development in Paris, and he has since been re-elected to that position. In addition, he has served as an expert for many O.E.C.D. Manpower activities, including the 1961 "Examination of Manpower Policy and Programs in the United States." He was one of the authors of the report "Skilled and Professional Manpower in Canada, 1945-1965", which was prepared for the Royal Commission on Canada's Economic Prospects. As of January 1, 1966, Dr. Dymond has been the Assistant Deputy Minister in charge of the Program Development Service of the Department of Manpower and Immigration.

PANKHURST K.V., On graduating from the London School of Economics in 1952 he was elected to a Dean Research Scholarship in the University of Leeds for research into the economics and history of the wool textile industry. He taught economics in three universities in the United Kingdom, was economist to an industrial development council and research economist at the National Institute of Economics and Social Research in London. In 1961 he became Director of Economic and Social Research in the University of Wales, Aberystwyth. He came to Canada in 1964 to start a Research Division for the Unemployment Insurance Commission, and joined the Department of Labour in 1965 as a senior economist. Since the inception of the Department of Manpower and Immigration in 1966 he has directed programmes of research concerned with Canada's future manpower requirements and with highly qualified manpower, including the design and direction of a major survey of scientific and engineering manpower. He has written and

published numerous works concerned with such subjects as short-term forecasting, international trade, regional analysis and policy, fixed investment, migration, long-term projections and manpower.

CAMPBELL DUNCAN R., Born Montreal April 30, 1935; Canadian citizen; married; two children. Education: B.A. University of Toronto, Honours Political Science and Economics 1958; Ph.D., Cornell University, Economics 1966. Academic Honours, Awards, etc.: R.J. Little Scholarship, Toronto, 1954. Ford Foundation Doctoral Dissertation Fellowship, 1961. Cornell Senior Fellowship, 1961 (declined). Phi Beta Kappa, Cornell Chapter, 1961. Phi Kappa Phi, Cornell Chapter, 1961. Thesis: *The Impact of Seller Concentration on Market Performance: A comparative study of the Canadian and American petroleum refining and marketing industries*. Publications: (1) "Public Policy Problems of the Domestic Crude Oil Industry, Comment"; *American Economic Review*, March 1967; (2) "Manpower Implications of Prospective Technological Change in the Eastern Canadian Pulpwood Logging Industry" (with E.B. Power), Queen's Printer, 1966; (3) Various articles in trade publications. Employment: 1958-1960, Teaching Assistant—Department of Economics, Cornell University; 1960-1961, Head Teaching Assistant—Department of Economics, Cornell University; Summer 1961, Lecturer, summer school, Cornell University; 1961-1962, Ford Foundation Fellowship; 1962-1963, Lecturer, Department of Economics, Yale University; 1963-1966, Research Economist—Department of Labour, Ottawa; 1966, Economist, Planning and Evaluation Branch, Department of Manpower and Immigration; 1967, Acting Director, Planning and Evaluation Branch, Department Manpower and Immigration.

MORRITT HARRY H., Born in Vancouver, B.C. in 1923, attended primary and secondary schools in that city and graduated from U.B.C. in 1945 with a B. Comm. Degree. Attended Cornell University in 1954-55 and received an M.A. in economics from that University in 1959. Presently the Assistant Director of the Manpower Information and Analysis Branch of the Department of Manpower and Immigration. Included among responsibilities is that of directing staff engaged in the maintenance of an inventory of Professional, Scientific and Technical Manpower in Canada and conducting surveys and preparing reports based on this inventory. An additional responsibility is for the direction of a Professional and Technical Occupations Section which has responsibility for the preparation of Career Outlook reports for graduates of universities and community colleges and various other reports which are distributed to Canadians studying in other countries in connection with "Operation Retrieval". Previously worked as a senior economist in the Pay Research Bureau of the Public Service Staff Relations Board, and prior to that as an administrator in the Industrial Relations Branch of the Department of Labour and as an economist with the Economics and Research Branch of that same department.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Wednesday, February 12, 1969.

The Special Committee on Science Policy met this day at 10.00 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, this morning we will hear from the representatives of the Department of Manpower and Immigration. Heading the delegation of representatives from that department is Dr. W. R. Dymond, Assistant Deputy Minister, who is concerned more specifically of program development.

Dr. Dymond is accompanied by Dr. D. R. Campbell, Acting Director, Planning and Evaluation Branch; Mr. Robert Lachapelle, Acting Director of the Research Branch. Mr. Harry Morritt, Assistant Director, Manpower Information and Analysis Branch, and Mr. K. V. Pankhurst, member of the Department of Manpower and Immigration.

As is usual, I would ask the head of the delegation to make an opening statement.

Dr. W. R. Dymond, Assistant Deputy Minister, Program Development, Department of Manpower and Immigration: Thank you, Mr. Chairman. I will try to make my opening statement reasonably brief. Honourable senators, I thought it would be useful to position the work on research and development in the Department of Manpower and Immigration within the context of manpower and immigration policy in Canada and in the work and objectives of the department generally.

Within the past decade, particularly, Canada, as well as other highly industrialized countries, has come to recognize how important it is to manage manpower resources effectively in the achievement of economic and social objectives. This recognition, I think, arose as we entered the so-called age of automation and we became aware of the speed and intensity of technological change and the problems it creates for people in adapting to new job requirements.

Those concerned with economic policy came to realize that in this kind of economy the human

factor in production is relatively more important in economic growth than is capital or the application of technology.

With this realization came a mounting concern for the strengthening of programs aimed at improving the qualifications and utilization of our human resources. The concept emerged of an "active manpower policy." An active manpower policy is basically concerned with helping people to respond effectively to economic and technological change.

Its purpose is to create the opportunities and conditions which allow people to obtain and hold jobs for which they are best suited and which, in turn, make them most productive.

Immigration is also a responsibility of our department and it has played an important role in the development of Canada's manpower resources and in the growth of its population. Immigration is now an integral part of our manpower policy and is a significant program element which helps materially, in meeting the needs of our economy for skilled, technical and educated manpower.

The flow of immigration has varied from year to year as the needs of the Canadian economy have varied and as economic conditions in the principal source countries have changed. In the years since 1946, approximately 2,800,000 immigrants have come to Canada and the children of post war immigrants have made up a large and important part of our population.

Canada maintains 46 immigration offices in 29 countries of the world and we encourage immigration on a completely non-discriminatory, universal basis, provided those desiring to enter meet minimum educational standards and can find a place in our labour market. We also provide for the reunion of the relatives of those who have immigrated to Canada. Our policy is based on the recognition that immigration is an important source of population growth, and that an expanding population is a source of economic growth. Immigration also has significant non-economic values which add to the social and cultural diversity of Canadian society.

As to the main kinds of programs that we have in the department, training is by far the most important

one in terms of money and human resources. The new Adult Training Program was introduced in 1967 and is financed on a 100 per cent basis by the federal Government, which purchases training for adult members of the Labour force from public training institutions, from private industry, and on some occasions from private schools. By far the bulk of the training is purchased from public training institutions through the provinces.

The training is directed not only to the unemployed, although they make up a substantial proportion of those trained, but to the employed and those requiring training to secure more productive jobs than they now have. We purchase specific occupational training of up to a year's duration, and beyond in some circumstances, and also provide general educational upgrading to enable workers with limited education to develop the more specialized skills required by our modern economy.

This present fiscal year we will have trained over 200,000 persons under this new program, and for the coming fiscal year it is estimated that we will have in training some three-quarters of one per cent of those in the labour force.

A major innovation introduced as part of this program is the provision of training allowances to all of those who are three years in the labour force or who are one year out of school and have dependents to support. In an economy of rapid technological change it is not possible to remove persons from production or to train unemployed who will take jobs if they become available, unless adequate income support is provided for them.

Another major function of the department is the public employment service, whose offices are now called Canada Manpower Centres, to symbolize the new concept of the local employment office as the institution through which all our manpower programs are implemented. These centres find jobs for workers, counsel them and help to meet the manpower needs of employers.

A basic function of the Canada Manpower Centres is to improve the speed of response of workers to technological and economic changes. It is in the centres that we make people aware of the opportunities and of the availability of training, mobility and other programs which can help them take better advantage of these opportunities. Our manpower centres have a two-way relationship to the labour market. They cannot give good advice to a worker unless they know what employers want. Employers will tell them what they want only if they know from experience that our manpower centres are skilful in meeting the employers' needs.

Another basic program is our Manpower Mobility Program, which applies to any unemployed worker for

whom we cannot find a job in his local labour market. It applies also to under-employed workers who work less than 30 hours a week and wish full-time employment, and to workers who are not utilizing their most highly productive and qualified skills. Under the program a worker can be moved on an exploratory grant to a labour market where there may be work for him to enable him to look for such work and to accustom him to the new community. Once the worker has found a job in another community, or our manpower centres have found a job for him, all travelling expenses for him and his dependents are paid, plus a relocation grant of up to \$1,000, based on the number of his dependents. In addition, the program will pay \$500 to facilitate the sale of his existing home or the purchase of a new home.

I might direct your attention next to page 4 of the brief, because that indicates the organizational structure of the department and will enable you to position the Program Development Service in the department. The Program Development Service is the service responsible for research and development and the current manpower information functions of the Department. If you look over to the extreme left of the chart under "Director General of Operations", you will see a line of authority from the Deputy Minister through the Director General of Operations to Regional Directors in each of the five regions of Canada. These regions embrace with in Canada both immigration and manpower functions under the same Regional Director, so that in Canada there is complete organizational integration between the two sides of the department's work.

Next is the Assistant Deputy Minister (Manpower) who is responsible for the administration and developing guidelines for the manpower programs of the department. Next is the Assistant Deputy Minister (Immigration), who is responsible for the administration of the overseas, in a line sense, functions of immigration, and within Canada for functional guidelines of the immigration aspects within Canada. In the middle are the usual service functions of the department in connection with personnel, information, financial and administrative services, and a special staff training and development task force.

My own responsibilities are indicated on the far left side of the chart. There are three major branches of the Program Development Service: a Research Branch, a Manpower Information and Analysis Branch, which has a very considerable field component at the regional and district level of our operations to provide local current manpower information, and a Planning and Evaluation Branch, which is concerned with program development, the development of new programs or changes in our existing programs and the evaluation of our existing programs. Within the brief there is a fuller description of each of these functions.

I think I might draw your attention to the fact that, so far as I am aware, the organization of the department in respect of research and development and program evaluation is somewhat unique in the sense that we have put at a senior—a level equal to and equivalent to people responsible for operational and administrative functions at the Assistant Deputy Minister level—a responsibility for research and development, so that it will assume an equal kind of weight and impact on the department's decision-making and its operations as the more traditional kinds of managerial and operational functions have. This is a growing trend, and in the federal Government organization I think we were probably one of the first departments to develop it in this sense.

Perhaps I might now briefly direct your attention to pages 8 and 9 of the brief. There, under paragraph 16, we have tried to outline in general terms the objectives of the Program Development Service, which are:

(i) analyzing the public need for policies and programs and determining the degree of need for new programs or program changes;

(ii) initiating and co-ordinating long-term program planning and conducting program analysis of the courses of action available to reach the departmental goals;

(iii) evaluating the impact, costs and benefits of existing departmental activities and sub-activities and recommending changes therein;

(iv) analyzing those recommendations concerning departmental policies and programs which emanate from the Canada Manpower and Immigration Advisory Council and Boards and domestic and international organizations;

(v) providing detailed, prompt, specialized and accurate labour market information analyses and research as a basis for departmental decisions on the purchase of training courses, the admission of immigrants, referral and mobility, and providing needed analyses to organizations and individuals to assist their decision making;

(vi) providing co-ordination with other federal departments and provincial governments in the above areas.

That completes my introductory remarks, Mr. Chairman.

The Chairman: Thank you, Dr. Dymond. Senator Thompson will initiate the discussion.

Senator Thompson: Dr. Dymond, I wonder if at the start you could give us a little bit more of the background, and tell us why on page 4 you partitioned your work. If I could quote from page 1, which is chiefly concerned with scientific activities into the three separate components, why have you done it in

this area of research, Manpower Information and Analysis, Planning and Evaluation Branch?

Dr. Dymond: The Research Branch basically is concerned with the longer term and more fundamental research activities in the field of manpower and immigration which would in a long run sense stand behind future changes in policy in this area or of the development of information that will be of guidance in day-to-day decision making in a long-run sense as distinct from the short term. If I could skip over now to the Planning and Evaluation Branch, the background research would enable any changes in programs and policies to be thought through and developed in a wider context than just an immediate day-to-day context.

Senator Thompson: In regard to the planning and the evaluation . . .

Dr. Dymond: The planning and the evaluation function is our evaluation of programs. That is to take our existing programs and to determine the degree to which they are effectively meeting their public objectives. One of the major tools we use in that branch for determination of whether they are meeting their public objectives effectively is benefit cost analysis and other kinds of analyses such as what happens to the clients of the programs as they go through them and that sort of thing.

A second responsibility of that branch is formulating changes in programs and all of this of course is done very much of a consultative atmosphere with the operational departments. You do not do that in a vacuum, but they sometimes head up a task force and in other ways direct the work on program changes or the development of new programs. Thirdly, they are responsible for the over all, at the departmental level, long-term planning system and the program forecast and review system that is used to make decisions on the allocation of resources. That is used to transmit our resource needs to the Treasury Board. Those are the areas that that branch is responsible for.

The Chairman: In other words, the Research Branch would be mainly interested in general research. I would say applied research or mission oriented research at a fairly high level and, for general purposes, the Planning and Evaluation Branch evaluates and advises immediately the policy makers within the department.

Dr. Dymond: Yes, that is right. Although the Research Branch will sometimes get involved in pretty immediate kinds of policy changes as well. Now, the Manpower Information and Analysis Branch is focused on the generation of current information on labour supply and demand. The regional and local levels of the branch have a field organization to serve the needs of our regional and local offices and at headquarters to

serve the needs for short term and current information on the state of the labour market.

Senator Thompson: Your Research Department, you say, would do long term research? Would you, for example, be doing work on the impact of technology on the worker? We had the Department of Labour last week. One of the questions that was raised was what is the program planning or the analysis of leisure time? I quoted some things that West Germany was doing about approaches towards shifts and preference for a longer holiday being of more benefit to the worker than just having a shorter work week. Do you do this kind of thing?

Dr. Dymond: Well, our focus of interest is different from that of the Department of Labour. We have a section in the Research Branch. It is not very adequately staffed at the moment, but it is devoted to the impact of technological change on manpower requirements, on the changing allocation of manpower, on what happens to the needs for manpower and on what knowledge people need to know within enterprises and within occupations. I might cite one study that Dr. Campbell undertook some time ago when he was in this branch, regarding the manpower requirements of the eastern logging industry as affected by technological change. There we have been having some pretty dramatic kinds of changes in these big harvesters and the new equipment going into that industry. The focus of concern of our research in this area is on the impact of change on the manpower requirement side and on what skills and knowledge workers need to have as a result of changing technology. That information hopefully in the future will have an impact on our overall forecasting of manpower needs and other studies that we are undertaking at the present time.

Senator Thompson: As far as your sort of sitting back and thinking of future implications—I have just taken technology as one—you say first that you are understaffed and secondly, you quote the logging industry which is an immediate problem. I imagine you are referring to this technology in the logging industry today. Have you got people who are sitting back and taking a long term look and doing research with respect to years from now?

Dr. Dymond: Yes, we certainly have studies going on of the future manpower requirements and supplies up to 1975 and year by year as to how requirements are going to evolve. We have research to get a longer run view of the impact of technology on manpower requirements and the whole adjustment process of manpower to changing technological requirements.

Senator Thompson: How many men are in this department?

Dr. Dymond: In the technological change . . .

Senator Thompson: In the Research Branch.

Dr. Dymond: In the Research Branch there are around 88 altogether at the present time, which is quite a bit under the establishment.

Senator Thompson: You bring up the Department of Labour, which is cut off from you. I sense that there could be the possibility of some gap between the two of you, perhaps I could enlarge on that. For example, I am thinking of regional development. You have emphasized the need for manpower utilization. Employment services and immigration are obviously related to regional development. So is the Department of Industry, and so are a whole variety of departments. It is all very well to be training a group of men somewhere in the Maritimes, but I can see a conflict between the Unemployment Insurance Commission, which is paying people because they are unemployed, while your manpower mobilization may be suggesting it might be helpful if you moved to some other place. In your brief the only mention of integrating various departments is that you have an informal discussion. Do you think this is adequate and do you not need a more formal mechanism so that you are not even, within your own department, working at cross purposes?

Dr. Dymond: I assume you are talking about research.

Senator Thompson: Yes. You mentioned the research as very closely related to services.

Dr. Dymond: Yes.

The Chairman: We were told, for instance, that the Department of Labour did not know what you are doing in terms of research, and I know that you were formerly with the Department of Labour. We were told this and also that you did not know what was going on in the field of research in the Department of Labour, except through very accidental and very informal communication.

It seems to some of us that there are areas of possible duplication but we are not too worried by duplication in the field of social and economic research, because there is so little being done, but there might be a possibility of important gaps. For instance, they say in the Department of Labour that they would like to do research on the impact of technology. You say that you are doing some of this, but not very much. Yet we are going through a period of most rapid technological change, where that change will have all kinds of influences on the labour market and on the way of living of the worker.

Dr. Dymond: I think the area of technology we are focussed on for the moment is an area which, in my view, has both industrial relations or labour-management relations dimensions and manpower dimensions, very clearly. At the point where we get active in doing the kind of research I think we should be doing in this area and we are not doing very much of at the moment, because of recruitment problems, we would certainly corroborate with and set up some joint discussions with the Labour Department in that particular area, because it certainly is one area in which clearly changes within industry have manpower and industrial relations dimensions that are very closely interlocked. There is no question about it. For that reason, it would be very specialized research that would focus on one aspect of it to the exclusion of the other. In that sense, there is room for jointly developed programs in that particular area.

Senator Thompson: Assuming you had doubt, what is your mechanism for the Department of Labour entering, when you wish to co-operate with them, and knowing they want to co-operate with you?

Dr. Dymond: I think the traditional mechanism is the setting up of an interdepartmental committee, to guide the research in that area. In fact, in this particular field, other departments such as Regional Development, and the industry part of Trade and Commerce, are also concerned with technological change. If one wants to broaden the horizons, the Science Council has some interest in this field.

Senator Thompson: But there is no interdepartmental committee existing at the moment so that you could be planning together?

Dr. Dymond: Not at the moment in this field. I was going on to say the labour and management also as organized groups have an interest in this field.

The Chairman: And the Economic Council.

Senator Thompson: Could I ask you do you think there should be an interdepartmental committee so that you could get that better co-operation?

Dr. Dymond: Yes, I think this would be helpful. I think it is a relevant comment to make that our problem at the moment in this area of research gaps is perhaps that we are too inward looking, if I may express it that way.

We see so many things that need to be researched from the point of view of the evolution and constant adaptation of our own policy and programs in the department. There are so many gaps right in what is our direct field of responsibility. We have not been very outward looking in looking for gaps in a some-

what larger context of the kind we are discussing now in relation to technological change.

In that sense, I suppose there is a gap here in the larger and longer term sense. We have not felt very pre-occupied with that kind of gap in the department, because of the realization of so much research which needs doing on our own doorstep, so to speak.

Senator Thompson: Within your department could there be conflicting policies? I would appreciate if you would comment on that. I am thinking of your manpower mobility program.

Just to get the picture of this in mind, what is the research that led to the initiation of this program, how is it initiated, and how is its effectiveness monitored? Is this program meant to be strictly a stimulus to interprovincial mobility, and how does this mesh with regional development programs and with the Unemployment Insurance operations? It may be that these three activities will work at cross purposes? I raise that as a question.

Dr. Dymond: I might give a little history and then turn part of the question over to Dr. Campbell, because he was responsible for some of the work leading to adaptations in the current programs.

The program got started originally in the period of the Department of Labour, the original and early version of the program. It was imported into the Department of Manpower with the Government reorganization in 1966. So the early research and other work leading to the design of the program occurred within the Department of Labour.

There was a certain amount of research going on in the mobility field but not a great deal, I think, and to be quite candid and honest, I would have to say that the original version, the early first version of the program was not particularly a product of a very elaborate or deep research.

The purpose of the program really is not particularly to pick up one part of your question, to move people interprovincially. In fact a great bulk of the movement occurs within provinces and within regions. The largest part of the movement occurs, as a matter of fact, within Ontario in terms of numbers moved.

Senator Thompson: Could I just interrupt? Why is it not interprovincial?

Dr. Dymond: There is some movement interprovincially, but I think it is a wise policy to move people no further than they need to move to get a satisfactory and stable job. So the movement tends to be from outlying areas in provinces into centers, or between centers that are declining to some extent and centers that are growing.

Senator Thompson: You do not think this would help in national unity if we were all moved around the country, that we would get to know each other?

Senator Haig: Are you not moving miners from the Atlantic coast to places out west?

The Chairman: And British Columbia. They moved on their own. That I know.

Senator Cameron: If I might interrupt Senator Thompson, I think there is a very general feeling that people do not know the rationale behind the separation of the Department of Labour and the Department of Manpower. This may have all kinds of justification but I am sure the general public, and many members of Parliament, do not know the reason why these two were divided up.

The Chairman: I am sure Dr. Dymond was not responsible for that.

Senator Cameron: No, no, I know that. I am satisfied that is true and I do not want to embarrass my friend Dr. Dymond. I could be embarrassing.

What does the Department of Labour do? What I would like to have seen was this chart which Dr. Dymond has prepared, showing the way his department is organized—and it is very good—put alongside a chart of the Department of Labour.

The Chairman: You have it in the other brief.

Senator Cameron: I would like to see them side by side, because I feel that there can possibly be duplication in the way it is set up now.

Senator Thompson: The gaps that occur.

Dr. Dymond: If I might comment on the duplication point—I will not, I think, comment on the reason for the Government reorganization act. From what I know of what the Department of Labour is doing, I do not see much real area of duplication of research and development activity, except possibilities in the one field we were discussing earlier, of studies of technological change because of the nature of the phenomenon.

In the Department of Labour, as I understand it, the research would be oriented to questions of wages, working conditions, labour standards, industrial relations, labour management relations, the kinds of changes there should be in the Industrial Relations Act, and these kinds of questions.

The Chairman: These are the functions of the department, but we were told that their research program, although it has not been implemented yet, was much more ambitious in general than this. Per-

haps it would not be desirable that there should be such an extension of their research functions which would really go beyond the new specific functions of the Department of Labour, but certainly we were given to understand that their research programs might very well go beyond that.

Dr. Dymond: As I say, our policy is basically to do research within the framework of the department's objectives, policies and programs, and not to stray outside those boundaries except where there was participation in joint research activities, because they cover a wider frame of reference than the department's. But we find, quite frankly, as I hope comes through the brief, that we are really performing not really adequately enough in researching the areas that are part of the department's direct responsibilities.

Senator Thompson: I do not want to embarrass you by quoting the Gordon Commission; I do not know if you were connected with it. My colleague Senator Haig has told me that 1,500 Maritimers are moving out to Alberta, to the coal mines there. Turning to another aspect, I would presume that fishermen have seasonal employment and are compensated by the unemployment insurance offices. This would mean there would be encouragement for them to stay within their regions. On the other hand, you have a Manpower Mobility Program. To my mind there could be a conflict in this. Can you explain how this is not so, or do you yourself see any danger in it?

Dr. Dymond: I do not see any basic conflict, frankly. We are moving people to the closest employment opportunity, those people whom we have to move because there is no apparent prospect of their employment in the local area in which they find themselves. If we see a prospect developing in the reasonable future we will not move them, because there is no point in tearing up roots, which is a difficult process for individuals and their families, unless we see no prospect in that area. Therefore, our mobility work has to be, and I think is, pretty closely co-ordinated with work on regional development and industrial development in local areas and in regions. In other words, the intention of the mobility program is supportive of the regional development process rather than detracting it; it is where the regional development process and the process of bringing jobs to workers cannot work that our program comes to bear, first of all in the main to move people within provinces, and then, of course, between provinces if that cannot take care of the problem.

It might be useful to ask Dr. Campbell to quote a statistic or two on the size of this program, because it is relatively small compared with the total move-

ment of workers on a free and unassisted basis within Canada. In other words, our program is really to pick up people who are unable to move on their own. By far the majority of the movement, the vast bulk of it, occurs in a free sense, of people moving around the country to different or new or better employment opportunities rather than through our program, which is designed to support that element of mobility that would not occur without our kind of financial help.

Senator Thompson: Do you know what the Department of Industry is doing in the regional plan?

Dr. Dymond: Yes.

The Chairman: They are not doing very much now. These functions have been transferred to the new Department of Regional Development.

Senator Thompson: That is quite right. How do you relate to the Department of Regional Development?

Dr. Dymond: For example, when there is a FRED plan...

Senator Thompson: A what?

Dr. Dymond: A FRED plan. The fund for regional development. There is a plan for the northeast, New Brunswick, the inter-lake area of Manitoba and one being developed for Prince Edward Island. In those plans there is provision for the application of manpower training programs, mobility programs and counselling programs to tell people about opportunities. Where there is a plan of regional development in a depressed area, the mobility program becomes a part of the plan of moving people, either within the area or to other centres where there is more growth. In other words, it is highly integrated into the structure of a plan where one exists.

The Chairman: I do not want any comment from you perhaps at this stage, but in that sense most of these regional plans involve either greater mobility of labour or at least training or re-training of manpower in those areas. These plans are under the responsibility of the Department of Regional Development, the total plan, but the substance of the tools at the government's disposal comes from your department?

Dr. Dymond: That is right.

The Chairman: So it is a little bit confusing for us.

Senator Grosart: Referring to the question of definitions which Senator Cameron raised, I notice on page 3, paragraph 10, there is the statement:

The department is also involved in the ILO.

That is the International Labour Organization...

through our Department of Labour in matters related to manpower.

Could the witness explain that? This department is involved through the Department of Labour in matters of manpower. Is there a statutory definition of "labour" and "manpower"?

Dr. Dymond: There is a statutory definition of the responsibilities of the Department of Manpower and Immigration in the Government Reorganization Act, and there is a statutory definition in the old Department of Labour Act. Other than that I know of no statutory definitions. The reason this is phrased in this way is that the Department of Labour is the department that represents Canada at the ILO, the International Labour Organization, in all matters that affect...

Senator Grosart: Including manpower?

Dr. Dymond: Including manpower, because the ILO is an all-embracing organization that covers labour-management relationship matters, manpower matter, health and welfare matters, anything affecting the welfare of workers, their economic welfare as well as their social welfare. We participate in ILO committee meetings, work and research through the Department of Labour. In other words, they co-ordinate the activities of any government department, ours of the Department of Health and Welfare, in ILO affairs. I must say they are very open and co-operative in any dealings we have with ILO.

Senator Cameron: Mr. Chairman, I still cannot get it out of my mind why it should not be the Department of Labour, Manpower and Immigration. This is a very big and complicated department, I know, but it seems to me...

The Chairman: You want to go back prior to 1966?

Senator Cameron: I am just wondering. I want to know the rationale behind it. As I said earlier, there may be very good and valid reasons for this, but I am not convinced.

The Chairman: You could go on and add the Department of Regional Development.

Senator Cameron: Exactly. The Department of Labour as presently constituted is concerned with the administration of labour matters and yours is concerned with the longer range social implications of manpower program. Mind you, I like the idea of a manpower program. It has an inclusive sound or feel

to me, but to have these two related departments completely separated . . .

The Chairman: The Department of Labour now is really restricted to the field of industrial relations and the very directly related field of labour standards and conditions.

Senator Cameron: It is administrative really.

The Chairman: And this is quite separate in terms of policy responsibility. This is quite different from what the Department of Manpower and Immigration is trying to do. The area of duplication in terms of policy at least is much more wide and I believe much wider when we come to relate the Department of Manpower and Immigration to that of regional development. The area there is much wider it seems to me than with the Department of Labour.

Senator Grosart: We will have to summon you as a witness, Mr. Chairman.

The Chairman: No, but I think we are getting a little bit off the field at this moment because we are not really dealing with research at this point. We are dealing with Government organization.

Senator Thompson: Mr. Chairman, I think with research, our concern is the overlapping between different departments. Could I move to another area? On page 34 I was interested in the actual and estimated research funds by scientific discipline. Again, with respect, I consider economists to be particularly in it and looking at human beings, that you look on them from the terms of the economic production that they can develop and so on. I noticed that under economics it has gone up tenfold. I would have thought that one of the most sensitive areas that should be developed in your manpower would be under psychology and perhaps sociology. Surely it is the psychology of the people behind the desk who assess a man and suggest that he move to another area or be fitted for another job. There were several terms about the direction and the importance of this. Why is it that economics have gone up tenfold and psychology down? I don't know how much psychology has gone down—I am not a mathematician—but surely this table at the bottom of page 34 indicates it has gone down an awful lot.

Dr. Dymond: One should observe, Mr. Chairman, that this table, particularly for 1967-68, is almost impossible to interpret in terms of trends, because in 1967-68 this function comprised the Pilot Projects Branch which was concerned with the development of training and other measures to lift up disadvantaged people and put them into a position where they could take advantage of economic opportunities. Because that branch was operating in the

slow growth areas it was moved to the new Department of Regional Development. Its work is pretty highly integrated with their concerns and they did, in fact, as you can see from this table, utilize a lot of sociological and psychological work in developing that program. When you get to 1968-69 and 1969-70 that branch is no longer in this table so the trends are not very helpful here.

Now, as to the reason why we use so many economists, our works in the economic field, the functions and responsibilities of the department, as I indicated to some extent in my opening statement, are economic in character. In other words, our objectives are to stimulate economic growth and to better utilize the labour force and make it more productive, as well as to bring in immigrants to meet the needs of our economy. These are all economic matters and economic problems. That is not to say, however, that they do not have social and psychological dimensions. Of course they do, as you are suggesting in your comments, but the main dimensions, at least in our view, are economic and much of the work in this field of manpower has been done by economists. If one looks at the literature you will see that much of the pioneering work in this country was done by the Economic Council of Canada and some of the basic studies, prescriptions and analyses and proposals they made led to the setting up of the department.

I would not want to say that these are the right proportions. We are having a study following immigrants in order to see what happens to them after they arrive in this country and we are utilizing sociologists and some psychological skills on the study, because it has these dimensions to it. In the major analysis of our programs, and the diagnosis of the problems we face in Canada, for example, one very important kind of problem is the whole question of the trade-off between price and unemployment. We think our programs have a major contribution to make, and this is part of the reason for substantial Government expenditures in the area of our programs, in making a better trade-off between price and unemployment, by working on the structural side of the adjustment in the labour market. This is an economic kind of problem and the people that are making contributions to understanding and the development and analysis of the problem are economists. I am only citing one kind of example. I do not want to hold a brief for this being the right kind of proportion of our efforts between disciplines in the future.

Senator Thompson: I am thinking, Dr. Dymond, of a study in the United States regarding their employment service a number of years ago. There was considerable public concern regarding the employment services, the question being raised why the are private industries with professional staff, and

others going to private enterprise organizations. I am thinking of what an opportunity there is to examine the kind of counselling that should be set up. There may be people in your counselling offices that have a tendency to be sergeant majors, but have not had the training. I think this should be one of the emphasis that you should be doing, which is in psychology and sociology.

Dr. Dymond: You are certainly quite right in the counselling level of training. These people are taking courses and programs that are very heavily sociologically and psychologically oriented. We have not been doing much research in that area on the counselling process. There is quite a body of knowledge and literature in that field. But you are quite right, at that level. We do not employ the skills of the economist in counselling out on the job, we employ the skills of people who understand people and their problems and how to give valid advice about them.

Senator Thompson: I am thinking of a study to see how effectively this is being done, as guidelines for those people. I would suggest this to you.

Dr. Dymond: That would employ these kinds of skills, certainly.

Senator Thompson: Could I ask one last question, as I know others wish to take part? This is in the whole range of immigration. I am thinking of Corbett's book and of Mackenzie King's phrase, "absorptive capacity". What he meant by that I am not sure or by "keeping the fundamental character of the Canadian nation". What does "brain drain" mean, and whether actually by bringing immigrants in are we really just satisfying the needs of the United States?

I have many questions but I will just ask you that. Do you think it is a substantial statement to say that the flow of immigrants coming in are moving to the United States after taking training and adaptation in Canada?

Dr. Dymond: No, I do not think that that is a substantial kind of problem.

Senator Thompson: How do you know, Dr. Dymond?

Dr. Dymond: I am going to ask some of the other people to respond in more detail; but in general one statistic that impresses itself on my mind is that the second most important source, after the United Kingdom, of professional and technical manpower for this country is the United States. Therefore, while we have a net deficit position vis-a-vis the flow between Canada and the United States of professional and technical manpower, the gap in this

deficit position is narrowing all the time, if one looks just at those two countries.

If one looks at our total intake of professional and technical and other kinds of manpower, as compared to the immigration outflow to the United States and other countries, we have a very heavy positive balance, of course, of very substantial magnitude.

If there is any criticism to be made of Canadian policy, I would think it would be the countries of western Europe and the United Kingdom which would make that criticism, for our impact on their "brain drains", that would constitute a substantive kind of criticism of Canadian policy, from their point of view, not from the Canadian manpower point of view. I might ask Mr. Pankhurst to say a word, as he has done a lot of research on this area.

Mr. K. V. Pankhurst, Chief, Manpower Requirements Section, Department of Manpower and Immigration: I think the main point about the "brain drain" is that it is something of a fallacy. Should we consider its magnitude, there seems to be an impression that we have a very heavy loss to the United States. It is an impression which has been created because the statistics that we have of the movement between Canada and the United States are incomplete, in that they do not show the figures of returning Canadian residents who have been to the United States. Very large numbers of them go there for their higher education. As a result, the impression has been created that perhaps seven-eighths of the people who leave Canada for the United States remain there, whereas the calculation which I have done suggested that the proportion which remains in the United States may be half or possibly even less than that, and that at least half return.

I think the important thing about this movement is that the people are going to the United States to get their education and so in fact the Canadian economy is benefiting to quite a large extent from the investment in education which our southern neighbours are providing for us, and so generating a part of our manpower resources.

Senator Thompson: Have you read the Medical Research Council statement?

The Chairman: Fifty per cent seems to be a fairly high rate just the same, if you say that 50 per cent do not come back.

Mr. Pankhurst: I put that as a maximum. It may be much less than that.

Senator Bourget: Have you any figures on the movement of these technical people?

Mr. Pankhurst: We do not have very good figures on that, because a Canadian resident who goes to the

United States does not become recorded in the statistics of people returning to this country—so we can only make a few guesses about it.

Senator Yusyk: The situation has improved since the 1930s, pre-war, because I gather that the brain drain was considerable before the war, and that the position has improved since then.

The Chairman: It has improved since Vietnam, too.

Dr. Dymond: It has been improving quite rapidly in the last two or three years, again I think partly because of the tightening up of the United States immigration regulations, which occurred a year or so ago. This means that no one can get into that country unless he has a pretty firm kind of job that is not competitive with the American labour market. So our deficit position has improved very markedly in the last few years.

Senator Thompson: I always used to feel that immigration was a very scientific process. In reading through the three case histories that you have, I find that you are now doing a job vacancy survey, which you never had in Canada. I find that was an extraordinary omission over the years. I was led to believe there was a very systematic approach in adapting the immigration—to use this term again—the economic absorptive factor in manpower capacity. This might give us an answer to the question?

In regard to the professional and technical manpower survey which you mention at page 53, it seems to me that is also vital. We in this committee have listened, for example, to Dr. Gray telling us that Canada faces a glut of scientists unless the system changes. On the other hand, we have heard that we do not have enough scientists. On your remark about not being too concerned about the flow of professional people to the United States, the Medical Research Council, in their report, appeared to be desperately concerned about the number of doctors, not only immigrants but native born doctors, who have gone to the United States. Following a question which was raised by my colleague Senator Bourget, I feel that in some way it is essential to try to get these figures. I appreciate your difficulty with the fact that once a person comes as a Canadian resident, he does not have to report. Is there any way we could change our law to make this effective for research purposes?

Dr. Dymond: I think, it would create quite a burden. The thing we are deeply concerned about is to retrieve Canadians who are studying in the United States and other countries, and we have mounted, in co-operation with the Association of Universities and Colleges of Canada, quite an extensive activity known as "operation retrieval." This involves teams

which tell Canadians who are studying in the United States and in Europe the opportunities for them in the Canadian labour market. They try to make a link-up—and this is pretty extensive—with employers in the Canadian labour market. Thus, they are exposed to our labour market as much, hopefully, as they are to the labour market in which they are studying.

I do not want to leave the impression that we are airily unconcerned about this problem. We are very much concerned with it. If we are talking about the loss of people, whether it be immigrants or native Canadians, to the United States, fundamentally this is pretty much a question of the extent to which we have challenging and economically attractive opportunities in this country for people with scientific, managerial and other kinds of relatively scarce skills. It is that side of the policy, I would say, that should be worked on to make this country as attractive and challenging as possible for Canadians, whether they have come to Canada from abroad or are native Canadians.

Senator Grosart: Has there been any qualitative research done in this field as opposed to quantitative research, which is the mere counting of heads? We are often told—and Professor A. R. M. Lower has said it on many occasions—that we lose the best and get the worst.

Dr. Dymond: Perhaps I might ask Mr. Pankhurst if he knows of research on the qualitative as distinct from the quantitative side.

Mr. Pankhurst: There is the longitudinal study.

Dr. Dymond: Mr. Pankhurst mentions that we will, I think, be getting an insight into this question through what we call a longitudinal study, which is following a representative sample of immigrants for three years to find out what happens to them. That will tell us something about the quality of the people who come, the activities they engage in and what kind of contribution they make to our economy. Certainly as a matter of impression, I must say, I think we are doing pretty well on the qualitative side of the immigration movement in recent years. Our statistics reveal very substantial increase in the proportion of skilled, technical, professional and managerial as compared to the early post-war years when there was a very heavy inflow of people with modest skills and modest educational levels. Our present selection system puts quite a heavy weight on education as one of the factors of eligibility for admission to Canada. As you probably know, we are criticized to some degree for that kind of scheme by countries who feel population pressures and so on outside this country.

Senator Grosart: Has any research been done on built-in restrictions of professional associations in Canada in the immigration field?

Dr. Dymond: Yes. We are engaging in quite a substantial project in the Research Branch on that question right now. We are looking at all of the trades and professions to see whether, and to what extent, there are restrictions of the kind you mention that inhibit acceptance of the qualifications, provided they are valid of course, of immigrants in the professional area. We have had quite a bit of liaison, and I think fruitful discussions, with the medical associations, the engineers and the agricultural profession on these kinds of questions. I have been active in these discussions and I personally detect a good deal of flexibility and responsiveness to the problem. I am not suggesting it is ideal yet by any means, but I think progress is being made.

For example, we have an offer to any professional organization, and this presents a very difficult problem considering the variety of countries from which we bring immigrants, and our extension of immigration throughout the world through the universalist policy—to study the educational equivalents of their professions in other countries so that they can make valid judgments about the equivalent foreign education and experience in Canadian terms. I think there is some response to this offer, and a good deal of smoothing of the immigration procedures to make them more efficient, to make assessment of qualifications by engineering organizations in the provinces a quicker and more efficient kind of procedure.

Senator Grosart: My question really related to research. I am asking whether anything has been done. Is there a paper or anything...

Dr. Dymond: No, there is not.

Senator Grosart: Just let me finish. Is there a paper that outlines these inhibitions, in say unions, the medical profession or the legal profession? We as a committee are concerned with these inhibitions and we want to know. Is there any information available? Has somebody had the courage to sit down and say, "Here is an inhibition in apprenticeship rules and union regulations. Here are the inhibitions against doctors in the medical profession. Here are the inhibitions in the legal profession and other professions"? Surely this information should be available, although I do not say in a critical way. What are the inhibitions?

Dr. Dymond: As I said, we are making a study. As the study progresses we issue briefs, for the use of officers overseas and potential immigrants overseas, called Entrance Requirements for various professions and occupations. I can make these available to the committee. They outline in some detail the

requirements the immigrant must meet to gain acceptance in the profession or trade. This can certainly be made available. We are making a good deal of progress in the preparation of this material for use in the immigration program, and it outlines the kind of requirements you are talking about.

Senator Grosart: In view of the fact the inhibitions I am referring to are not part of our national immigration policy as such, have you made any critical comment to any of these organizations on the validity or otherwise of these non-statutory inhibitions that are keeping people out of the country, or discouraging people from coming?

Dr. Dymond: No, I would not say we have as the federal Government made any critical comments, because this is something that is firmly within provincial jurisdiction, namely legislation concerning trade qualifications and that sort of thing. It has not been a matter of federal policy to be critical of something within the provincial jurisdiction. It think it is well known, however, through speeches of the Minister of Manpower and Immigration, that we would like to see an objective and liberal approach taken to the question of trade and professional qualifications.

Senator Thompson: Following on Senator Grosart's question, we know that the medical associations in the United States have, through a national body, set up a means of evaluating the standards of undergraduate work in medical school throughout the world. We know that in Canada the different provincial bodies, with the smallest of staffs, and so on, reject the standards set by the American association and say, "Look, we will establish our own standards". These are the sort of facts it would seem to me, without being critical or otherwise, should be expressed in this committee and to the public, knowing there is a desperate need for doctors.

When an immigrant comes in—let us say he is a electrician—he faces a very frustrating experience. I don't think that Canadians generally realize what happens. The immigrant electrician will apply to join a union and be told that he is ineligible to join until he has Canadian experience, whereas he cannot get Canadian experience before he joins the union. He finds himself in a vicious circle of frustration. I think in some ways we are not being frank to the public with the facts. You tell the immigrant in the overseas office that he is needed, but it does not get through to him the enormous frustration he is going to face in Canada. I suspect we are wasting an enormous creative energy, talent and skill because of these barriers and I feel it is up to the department to get facts and put them up against other situations in the States, other countries and send this to editorial pages across the country. It is up to the Canadian people to judge how they feel about it.

Dr. Dymond: I should say in relation to the doctors, it is my understanding from discussions with them that they are divided, depending on what professional organization you are talking about. Some of the organizations prepared to use the U.S. test of equivalence.

Senator Thompson: Could you mention any province that is actually doing that?

Dr. Dymond: I think the Province of Quebec has a French version based on this examination and, in fact, we conduct examinations overseas for the medical profession in Quebec. Other medical associations are expressing some interest in this proposal. The research I mentioned is going to try to dig into this question you are raising. Undoubtedly, this is a very crucial and important question.

Senator Grosart: Is there not a step that goes beyond the mere comparisons of equivalence? Is there not a responsibility on the Department of Manpower to go beyond this and say, "Are these standards valid?" We know what it takes to get a job as a longshoreman in Canada, the skills and the qualifications.

Dr. Dymond: I think the problem, senator, is the one I mentioned.

Senator Grosart: Provincial partly, but not altogether provincial.

Dr. Dymond: It is in so far as there is legislation in this field and it is provincial legislation. I think we have a responsibility (a) to tell the immigrant the facts and we certainly try to do that and (b) to undertake research, as I indicated on the nature of this problem. From the research might flow some policies and steps toward a more active posture in this regard, but I think I would have to say it is delicate because of this question of provincial jurisdiction in this field,

Senator Thompson: Do you think you have the responsibility to tell the Canadian public the facts?

Dr. Dymond: Well, I think any good research done by Government or any place else should be put on the table and be a matter of public record. That is my belief, unless it is going to be against the public interest of course, for some reason or other.

Senator Yuzyk: Could I ask a question about research in general. We are dealing with immigration right now. I have been looking at this supplement, particularly at page 3, By Research Branch (Immigration and Foreign Manpower Section) and I note that there are certain projects here, most of them not completed. There are only actually two comple-

ted. We realize of course that Canada puts a lot of stress on immigration. When I look at this list I am not very impressed with the research that is being done on immigration. Perhaps this is not the whole of the research that is being done or contemplated. Certainly a great portion of our population are immigrants and it is of great importance to us to know, for instance, not only immigration, but the adaptation and the integration that takes place and we do not have very many studies in this field at all.

I am glad to note that there are some good beginnings here, the results are still in the future and I would think that this would lead me to believe that either your department does not pay enough attention to research or else you are not given the money to carry out the research that you would like to do. Now, you can correct me if I am wrong. Could you give us a general explanation of the research aspect of the department, say of manpower in this case.

Dr. Dymond: On the immigration side, senator, this may look sort of innocent, a longitudinal study on immigrants: economic and social integration of a representative cohort of immigrants during their first years in Canada. This is actually a very large and major study that will cost hundreds of thousands of dollars. In other words, it embraces a sample of 10,000 immigrants that come in every year.

Senator Yuzyk: I am glad you explained that. You would not gather it from this brief statement.

Dr. Dymond: I was going to say the brief statement is not very enlightening.

Senator Grosart: Excuse me, what page are we on?

Dr. Dymond: Page 3 of appendix C. We will follow those immigrants at six-month intervals with interviews, both mail and personal interviews over a period of three years.

Senator Yuzyk: This started in 1967?

Dr. Dymond: Yes, there was a lot of development work behind this in 1967. It actually started January 1 of this year, that is actually picking up samples of immigrants. From it will flow a great deal of information, knowledge and studies. It will be comprehensive so we will know every group and every occupation and every area of Canada and what happens to the immigrants. In other words, instead of a lot of partial studies which have been done in the past, such as a particular group in Toronto, Montreal or Calgary or what have you, most of these ethnically based studies, this will be completely comprehensive. As I said, it looks very innocent here: four lines, but it is a major study of immigration.

into Canada from which will come our basic knowledge in the future of what happens to immigrants. We will then feed that knowledge back into the development of immigration policy and into our selection procedures, into our counselling and so on. In other words, it will be the major way in which we will be able to keep track of what is happening to immigrants in this country with a view to improving our performance in selection and counselling, and, once they get to Canada, the adjustment side.

Senator Yuzyk: This work would be done not only in Ottawa, but various centres in Canada?

Dr. Dymond: Throughout the whole country, but the work will be co-ordinated in Ottawa and the data analysed and developed in Ottawa and then fed out into our whole system, both overseas and in this country. We hope to have some rather major studies that will be published and flow from this basic longitudinal study, as we are calling it.

Senator Thompson: Are you saying that at this point we do not have a study? For example, when here was a decision that immigrants had to have a skill did the Government know there would be economic benefit to Canada by admitting a hundred unskilled young Italians, say, and training them at public expense here. If the Government did know this, then it is saying that only the skilled will be admitted, and the unskilled will be excluded. Has it been based on having looked at it economically to arrive at a decision on not bringing unskilled people?

Dr. Dymond: There were a number of studies relating to the requirements of the Canadian economy for manpower. There were a number of studies of unemployment. For example, quite a study was done by the Senate itself some years ago under Dr. Deutsch or with the assistance of Dr. Deutsch, on unemployment, the kind of people who were unemployed and the kind of people who become unemployed, where they come from. That kind of information was relevant to the development of the policy.

As one looked at the future, obviously more and more education was going to be required by the average member of the labour force, regardless of most of what occupation he was in, in order to cope with technological change. I think these kinds of studies were relevant for the shape of the new immigration policy that was introduced.

We do have individual studies by individual scholars of particular groups and their adjustment problems, of which there are quite a few, incidentally. They are not recorded here. What we are trying to accomplish through this longitudinal study is a

comprehensive all-embracing look at what happens to immigrants.

Senator Thompson: If 50 Italian families in Toronto—or any other group—said to me, "We would like our young people to be coming in," could I say that the Research Branch of the Department of Manpower and Immigration had done a study on this, to substantiate that if they did not have skills the cost of retraining them to fit into the Canadian market would not be justified, because over the long haul it would not be repaid? Is it on that basis we are not letting unskilled people come in?

Dr. Dymond: I would not quite say that was the basis. I think it was that we face more economical alternatives, through having the capacity to import and bring in people who have the skills already or, in many cases, retraining with modest expenditures people already in Canada, rather than people who have very low levels of education.

Senator Thompson: I appreciate this. I am assuming that each year consideration is given to the extent by which our population should be increased by immigration in order to benefit Canada. You probably are unable to get your quota of skilled people from Europe or the other countries you are trying to get them from. Have you therefore considered whether bringing unskilled people in would be detrimental economically?

Dr. Dymond: I think we are going to have firmer views when we see what happens under the new selective system. Quite a number of unskilled people come in as a result of the right of Canadians to sponsor, both in regard to nominated relatives and to straight dependants. We will be following this up to see what happens to them in our labour market. I would not want to make the case that we are uninterested in them. It is a matter of the relative proportion, basically.

Senator Thompson: Do you know if they have been a burden on the Canadian taxpayer or have you been able to do any study on the sponsoring of unskilled?

Dr. Dymond: The sponsor takes on an obligation to support the dependants, so in theory they should not become a burden on the taxpayer—although they become a burden on someone if they cannot get adequate employment in the labour market.

Senator Bourget: Have you got statistics on the unskilled labour that is coming in?

Dr. Dymond: We have statistics by occupation of immigration, quite detailed statistics.

Senator Bourget: Have these been published?

Dr. Dymond: Yes.

Senator Bourget: Through your own department or through the Dominion Bureau of Statistics?

Dr. Dymond: Through our own department.

Senator Thompson: I do not think the Canadian public is aware of the economic contribution which an immigrant makes to Canada. You can hear this from various private groups, but surely in order to get a receptivity from the point of view of the public there should be studies by you to show the economic contribution made by immigrants. Australia, I understand, goes in more for retraining of immigrants. I am not sure of the retraining area.

If the Canadian Government were to bring immigrants over and retrain them, there might be an outcry by sections of the public unless it were pointed out that this would really be of economic benefit, that the cost of retraining immigrants, on a long-term—and probably on a short term—would really be paid off. I am asking about this, as I think this is an area where you should be effective.

Dr. Dymond: I might ask Dr. Campbell to respond to that. We have quite a comprehensive study of retraining, what its costs and what its benefits are and the extent to which we are retraining immigrants. As we are training many immigrants in skills and in language and in basic educational upgrading, we will be able, I think to sort out immigrants in this analysis, this kind of a benefit cost model of our adult training program. Is that right, Dr. Campbell?

Dr. Duncan R. Campbell, Acting Director, Planning and Evaluation Branch, Department of Manpower and Immigration: That is correct. We will be able to sort them out, although I do not know that that really would provide the answer to the question you are asking. The preliminary indication we have—and that is all it is—is that we are getting back a good benefit cost-ratio for training immigrants—although what we are doing mostly is providing them with either French or English, when that is needed to utilize their skills.

As Dr. Dymond has pointed out, we have a fairly rich skill mix amongst the immigrants and it has made very good economic sense, quite aside from all the social values, to provide those people with training in French or English to enable them to make their contribution as rapidly as possible in the occupation for which we brought them to Canada.

Senator Thompson: I remember a Member of Parliament, Dr. Maloney, who came from a very large immigrant riding. He did research on his own and found that after three or five years an immigrant had

made a down payment on a house, and had acquired a car, a refrigerator, and other appliances.

I think it would be helpful if the department were to provide this type of fact as it applied right across the country.

Dr. Campbell: This sort of material will be coming out of the longitudinal study that Dr. Dymond mentioned.

Senator Yusyk: For our own information I think it would be very beneficial if we had an outline, say, of this longitudinal study. I would also include this study of the analysis of the social and economic adjustment of immigrants. We want a detailed outline to give us some idea of how to attack the whole problem, what has been achieved so far, the results that have been achieved and what we can expect in the future.

Dr. Dymond: We would be very glad to provide that or any other details of any of these studies that are briefly listed here. In reply to the questions on the economics of immigration, I think it is not too strong to say, as economists, that we do not have a firm kind of detailed analytical or theoretical view of the role immigration plays in the process of economic development and in the process of growth, in relation to the business cycle and so on in this country. When we examine the literature of economics we find remarkably little guidance on this essential and crucial question for Canada, so we are launching a study of the economics of immigration—if I can put it that way—in a fairly basic way.

We have contracted with a professor to start a study at Simon Fraser University. We also in time hope to build for our guidance a benefit-cost model of the immigration program, to see what the benefits and costs are for various kinds of immigrants and the various parts of the immigration program, with also something about the timing of the economic impacts of immigration, about which we know very little.

I think we are probably geared to a kind of short-run context when thinking of immigration. Many people say it is inappropriate that we should have a longer run view, so we will certainly try to do a good deal of research and analytical thinking to establish these kinds of parameters for our immigration program in the future. There has not been a lot of writing about immigration in this way. It has been rather historical in character and not very analytical or theoretical in content, to provide a guide for policy.

Senator Bourget: Would not the Canada Manpower and Immigration Advisory Council give you some guidance on that?

Dr. Dymond: We hope so. We hope both the council and the advisory board on research would contribute, and we would hope to put the results of such studies before them for their conclusions and advice.

Senator Bourget: Has this council been established now?

Dr. Dymond: It is in the process of being set up.

Senator Bourget: It has not been set up?

Dr. Dymond: It has not been set up yet.

Senator Bourget: Are funds holding you back at all from carrying on some of these researches?

Dr. Dymond: No, I would not say funds are holding us back. It is lack of people that are holding us back, our inability to recruit adequate professionals who can conduct research in this area, not the total size of the budget.

Senator Bourget: You mention in the brief that one of the hindrances to carrying out the project was the fact that the scientists were not offered high salaries. You mention that somewhere. I do not know exactly where.

Senator Thompson: On page 1 at the bottom.

Senator Bourget: What kind of salaries are you offering to economists and scientists, and how do they compare with salaries paid to economists in other departments?

Dr. Dymond: I think the comparison with economists in other departments is reasonably favourable. I do not see a problem there. I think the Government does a pretty good job of making sure the balance is maintained.

The Chairman: No departmental disparities.

Dr. Dymond: I might not be that blunt. I do not have detailed knowledge of all the disparities. At the moment the top professional salary range is from \$17,408 to \$18,646. To get that kind of salary in our sort of organization you would have to do a considerable amount of administrative work because it is at our section head level; you could not get that kind of salary to do research and nothing else. I think this is partly the problem we are alluding to in the brief.

Senator Bourget: The inadequate salary level offered.

Dr. Dymond: Today to get people to do sophisticated research requires typically a PhD degree with three, four or five years experience. Our reading at the moment is that we are not very competitive. We have been out in the market trying to get people and we have not been very successful. I think part of the suggestion here is to find ways and means of recruiting people and paying them salaries competitive with what they could get in universities, which in our kind of research is probably the principal competitor, and industry to a lesser extent. That might require the creation of some positions that do not have too much administrative responsibility but would have primarily a research kind of a responsibility at a reasonably senior level. I think it is possible to have a situation where some people are primarily interested, equipped and effective in administration to be paid about the same amount as people engaged on their own without too much direction on a pretty sophisticated, difficult and complex research project. In a hierarchical structure, of course, of the kind you typically find in government, this is difficult to manage.

Senator Bourget: Are you doing your recruiting yourself or is it done for you by the Public Service Commission?

Dr. Dymond: It is done through the Public Service Commission, who hold competitions, advertise and so on. We have been fairly active in making our own contacts with people. The officers of the Program Development Service at branch head level go out and talk to people, interest them in our work and so on. It is basically a joint activity.

Senator Yuzyk: Do you seek the co-operation of professors or scholars at universities, in co-operation with certain departments? For instance, I would imagine some of these can be farmed out to certain universities who would try to specialize in that field, and you could get some of this work done through programs for Ph.D. degrees and the like.

Dr. Dymond: We have a number of projects out on contract to university professors. We use that method fairly extensively, as well in some cases, if they are big projects which require survey capabilities, consulting firms. I would say that mainly our contracts are with university professors. We have, of course, a grant program under which we give grants to people who are capable of doing research. Again it is mostly to university professors that we make grants on subjects of concern to the department. It is referred to in the brief in this area. We are finding that due to staff shortages we are having difficulty getting as much contract research done as we should like. I would not say this applies to grants, but contract research requires a lot of internal management to outline the project, discuss it and monitor it from

the department's point of view. All of this requires scarce and talented staff time so that your ability to get the research done, extramurally in part, is related to your capacities internally. Certainly, we have no posture at the moment of trying to do research internally that could be done externally. Our job is really to get as much research and development work done as we possibly can because of the big gap between our need in this respect and our capacity to produce.

Senator Grosart: Could I ask if any research is being done in the immigration sense in such matters as relative discrimination between various types of origins of immigration. On the entrepreneur factor, the degree of impact of entrepreneur into the economy from immigrants, the capital inflow which is incidental to some kinds of immigration and the effect on imports and exports, the relationship say in criminology. Are you doing that kind of study or is anybody doing it?

Dr. Dymond: As I said, this so-called longitudinal study will provide some data in this respect. We do separate in our statistics entrepreneurs from other occupations. I think the department has collected in the past some data and I know they have on the resources of immigrants, for example, those who bring capital with them. There have been in the past, and I think we are still collecting them, some case study materials on cases of successful entrepreneurship from immigrants and the kind of contributions they have made to the economy. On the question of discrimination I do not think we have overtly and substantively looked at that question from a research point of view. I think some of the private studies have come up with a number of views because they have been pitched at particular ethnic groups. That has been a focus of interest and concern.

The Chairman: In general, would it be true to say there was very little research being done in the former Department of Immigration and Citizenship?

Dr. Dymond: Yes.

The Chairman: This is probably one of the explanations of all of these questions. Your research effort really started, for all practical purposes, in 1966.

Dr. Dymond: Yes, I think that is correct. I think in terms of people and money our present research would be multiplied by a factor of many times as compared to before 1966.

The Chairman: That is why we have some unknowns now.

Senator Grosart: You did not say anything about the criminology aspect. I am not bringing this up in

a critical way. I am one who believes that when someone gets into trouble with the law it is a question of adjustment.

The Chairman: Would not that be a responsibility of the Department of Justice or the Department of the Solicitor General doing research on criminology in Canada rather than . . .

Senator Grosart: That is what I am asking the witness, Mr. Chairman. I would like to have your answers, but I would also like to have . . .

The Chairman: Do not start to be difficult again.

Senator Grosart: I would also like to have the witness's answer because I did mention this and I just want to know.

Dr. Dymond: I did not ignore it deliberately. I do not think we have any data on that question.

Senator Cameron: If I might respond to that. No, we have not been doing any studies on that and do not have any data. There was a study some time ago by the Dominion Bureau of Statistics, the results of which I assume are still valid. There is no reason to assume any changes in the low rate of criminality amongst immigrants.

Senator Haig: What about the health position? This is still an important factor, am I not correct?

Senator Cameron: It is a very important factor in his admission. The immigrants, in addition to their suitability and the need for their skills, are screened both with regard to health and criminality overseas, which is of course a lot of what keeps the criminality rate low amongst immigrants.

Senator Haig: Where is the health study made, the health of the immigrants discussed? Is it made at the port of departure?

Dr. Dymond: He is checked before he is granted a visa to come to Canada. A medical examination is made and a health history. Certain health problems are in the non-admissible classes, as is much criminality in the non-admissible classes. One would expect that if we are administering the act at all effectively we should have a much lower rate of criminality among immigrants than among the population generally.

Senator Grosart: I raised the question only because I see it as a form of maladjustment. I am not for one moment suggesting that any particular source or origin of immigrant is more prone to criminality than any others.

Senator Thompson: I would like to follow on Senator Grosart's question. I am looking at an abstract from the *New York Times*, September 1, 1968, in which it says there is an acute problem in getting employment in Canada. In this article your deputy minister is referring to the hiring of Indians. He gives this explanation:

"a reluctance on the part of certain individuals whom they have employed to adjust to a new work environment."...

What he was referring to was what employers and federal job counselors have described as a tendency for Indians to be more concerned with status than job content and to adopt an aloof attitude toward co-workers.

Would that statement be based on any research?

Dr. Dymond: Not in the sense of this detailed study that we have been discussing this morning. I think we have a lot of information, of course through our local offices or counsellors, our placement people on difficulties of placement and retention of employment of immigrants, because they come back again and again to our offices if they have trouble in the labour market. Of course, we carry immigrants on welfare payments from our department until they get their first job so there are differential experience among various groups from various countries on the extent to which we have had to carry them on welfare until they get their first job. Obviously, some groups are going to fit into the Canadian labour market more quickly than others. It is just a matter of some of the things mentioned there. The difference between our culture and other cultures creates a differential adaptation rate.

Senator Thompson: What they are saying in this article, in essence, is that Asians face a difficult situation with respect to professional and technical opportunities for jobs. This is suggesting that there is some form of discrimination across Canada. I notice that we are raising the numbers coming in. It would seem to me it is an area where a study should be made to remedy that.

Dr. Dymond: I do not think I would say that it is necessarily discrimination, personally. I think for many Asian countries, particularly India and Pakistan—not the Philippines and certainly not Japan—there is a really difficult problem of equivalence. In other words, the educational system in India, for example, while on the surface—we are doing some work on this right now—may appear to be comparable, a BA degree from an Indian university equals a BA degree from a Canadian university. It really does not, either in terms of the length of time it takes to

get one, which is several years shorter in many many fields or in the content and quality of what is taught. Much of the apparent difficulty of some Asians—I do not think it is true of all, by any means—in the Canadian labour market appears to centre on this question of equivalence between Canadian education and theirs. As a matter of fact, we are doing some work right now to try to get this problem sorted out, part of it in co-operation with the Association of Universities and Colleges of Canada.

Senator Thompson: Again I have some examples involving Indians who have trained and received their qualifications in Britain. Again what I am suggesting is that it is most appropriate to have research to get the facts of this and other groups.

Dr. Campbell: If I might respond to that, although it is not mentioned in our brief, because we have not formally undertaken it, I have recently had discussions with a group of professors at Michigan State who for some years have been researching the question of prejudice particularly in so far as it is related to colour, and these discussions are intended to lead towards a study of that question in Canada. The area of discrimination is one we have been concerned about. These other factors are important. It is always very difficult to say where the breaking line really falls, whether in an individual instance it is discrimination or whether it is based on a more substantive view of the person's likely performance. We feel a very definite need to deal with this question, and I am hopeful that these discussions will lead to a fairly significant study in Canada of the problems that these people are facing.

Senator Cameron: There is a specific group I am interested in. You are aware that Canada owes a tremendous amount to the immigrants who came here after the war so far as the arts are concerned. Our whole cultural development has been enlarged tremendously as a result of their coming.

The Department of Manpower and Immigration initiated that small experiment last year with manpower training or grants to train people who may be unemployed and who may want to upgrade themselves and their qualifications in some field of the arts in Canada. This covered people, who, for example, want to write for radio, playwriting, or people who want to be professional ballet dancers or who want to go on the stage or who want to go into the theatre. Have you done any work in trying to determine what the market is in Canada for people like this? In other words, we know there are a number of Canadians, some young and some fairly mature, who could benefit from and would like to take advantage of this training, but before extending a program of that kind to any great length, has

anybody tried to establish how many people we can employ each year in this country, say, as radio scriptwriters, short-story writers or people who would like to act for television, in ballet or in drama or whatever it might be?

Dr. Dymond: I think that as part of our forward projection and forecasting work on manpower requirements we would pick up a part of that although this kind of forward forecasting, because of the factors of technological change and unpredictability of some elements of social demand, which is the area you are discussing primarily, is a very difficult kind of thing to come to grips with in any sort of detail such as the demand for entertainers and musicians as compared to people working in, say, the television field generally. Mr. Pankhurst, have you any observations to make on that?

Senator Grosart: It is very hard to say how long rock and roll is going to last.

The Chairman: There is a cycle.

Mr. Pankhurst: I don't think we conceive it as any part of our program at the moment to try to produce projections in the kind of detail that the senator is asking about. There is a very large demand for projections of the future manpower of the Canadian economy and of the way that it might be distributed between different kinds of industries and occupations, and, at the moment, at the beginning of our program, we regard it as primarily our responsibility to try to do this sort of thing in a sufficiently general way to be able to set the context for examining the broad policy implications of it or providing a context in which other people can make their own projections and to advise them of methods of doing that sort of work.

Senator Cameron: Mr. Chairman, I saw much the same sort of results of this kind of experiment last year. It was a pilot project. I thought it was very successful. A lot of people are beginning to inquire if this is going to be incorporated as a part of the manpower training policy. I see no reason why it should not, but before we can say, "Oh, yes, we will pay your fees to go to summer school or to the drama department of the university", we should know how many people this country can absorb in that field. There is no use training people and then having them stand around not being able to get a job.

Senator Thompson: Does that not apply to the whole of the manpower training program? I have heard of people being trained to become welders when welders were not needed.

Dr. Dymond: The senator has hit an area where it is much more difficult to forecast because you are

talking about taste, essentially, and taste is an interacting process, as I would see it. You put before people certain things. For example, if they want to have more ballet, they must have some experience in order to really know if they want it, in the first place. You get a kind of circular or interacting process of demand built up, of which the supply in part creates its own demand, to get the kind of supply that seems to catch the public fancy or taste. I think the senator has hit on a difficult area for forecasting.

The Chairman: But to come back to a subject which is perhaps more directly related to our inquiry here, you made a survey of the professional, scientific and technical manpower in 1967. In the main brief you describe that survey from page 53 on. You say that this survey was based on 31 per cent of the number of holders of university degrees reported in the 1961 census. You then proceed to give tables of the distribution of this manpower between professions and disciplines and so on. Do you not think that most of these results are quite meaningless because they are based only on 31 per cent?

Dr. Dymond: That was merely intended to suggest that we are only covering a part of the highly qualified manpower field or the professional field. We are not pretending to cover the arts or lawyers or doctors or very many other professions. This is only covering scientists and a few fields of social science, economics, sociology and engineering. It is only a partial coverage that we are conveying by the 31 per cent of the total professional manpower spectrum.

The Chairman: All the professions listed in your tables are completely covered, however.

Dr. Dymond: In principle, yes. That is right.

Senator Cameron: I might interject that, having looked at two or three of them, I thought it was a pretty awful questionnaire.

Senator Thompson: Do you agree that there would be a glut of scientists, as we heard, or do you think there is a shortage of scientists?

Dr. Dymond: I might ask Mr. Pankhurst to answer yes or no to that question.

Mr. Pankhurst: In general, if we are talking about all the scientists and engineers, we have made some very preliminary projections of future needs, as part of a study we have in progress at the moment to make some projections for 1975. This is something we are doing with some urgency, so the techniques are rather rudimentary. However, we have provisionally estimated that the professional group as a whole—which was 7 per cent of the labour force in 1951 and 10 per cent in 1961—will grow to 16 per

cent in 1975, which will show the nature of the expansion of the demand for this kind of manpower arising from the growth of our economy and the expansion of the science-based industries which are using this manpower.

As far as the engineers and scientists who are covered by the survey are concerned, we do not at the moment find much evidence of any under-employment—that is, in the normal sense in which people are out of work; nor do we find much evidence of under-utilization, to the extent there are people not in the labour force. For example, of the people covered by our survey, 97 per cent were either in employment or were occupied as students in preparing themselves for employment, and only 3 per cent were outside the labour force—housewives or retired people.

Senator Bourget: How have you got this information, through questionnaires or different organizations? Let us take engineers for a moment, did you get in touch with the Corporation of Professional Engineers?

Mr. Pankhurst: The survey was conducted by means of the questionnaire, which a committee member referred to a few minutes ago, being sent directly to individuals, but it was done with the co-operation and collaboration of all the pertinent professional associations—for example, the Canadian Council of Professional Engineers and the Chemical Institute of Canada.

Senator Bourget: Our own Association of Engineers do the same kind of work. They send a questionnaire out every year about our salary, what we are doing, in what field we are. I was wondering whether, once again, there is no justification for this.

The Chairman: I do not think this is the only area where there is possible duplication. It seems to me there are a lot of agencies within the federal Government which are involved in trying to measure or make surveys on professional manpower in Canada. We have been told, for instance, that NRC has been conducting surveys in this field. The Public Service Commission is conducting, for its own purposes, surveys in this field. The Science Secretariat has been making surveys on manpower supply and demand. Then there is the Science Council. Of course, your department and also the Dominion Bureau of Statistics are interested in this.

Dr. Dymond: I do not think they are making any surveys.

The Chairman: The census.

Dr. Dymond: Yes, the census.

The Chairman: But it seems to me at some stage, especially since you lack good people in your own area and this is your specific field of responsibility, there should at least be more co-ordination in the field around your operation than seems to be existing at the moment.

Dr. Dymond: I think I would say I would not disagree with that remark. This survey has a very long history, in the sense that it grew out of the Wartime Bureau of Technical Personnel and has been conducted periodically, and it has expanded its coverage somewhat over the years since then. This is the latest version of the survey.

I might say that I think we are somewhat at a crossroads in respect of this survey in that we have to decide whether to extend it to further fields of professional and highly qualified manpower or not, and how frequently to conduct it. To really find out, in the sense you are talking about now, what are the interests of various groups that are concerned with policy and the data. We have to decide whether it should be extended, for example, to supporting groups to scientists, engineers, and other professionals—because the problem of utilizing highly qualified manpower embraces the support that they have and the problem of whether we have adequate and proper ratios of supporting personnel to professional personnel. There is a whole range of questions about the future of data collection in this field.

There is the question of bothering this element of the population with a variety of questionnaires from a variety of sources. People get more and more impatient with filling them in. This was expressed by Senator Cameron, I think. In the department we would appreciate any kind of guidance we can get on work in this area.

The Chairman: Have you been interested also in forecasting our future requirements in this field?

Dr. Dymond: Yes, I think Mr. Pankhurst has been expressing some very preliminary forecasts we have been making as part of a larger forecast of the total requirements for manpower. I think we have a feeling that in the field of science and engineering and social science you really have to use a common methodology, and have it within a co-ordinated context; that you really have to do some detailed work, field by field, in co-operation with the people in the field, or with associations and professional bodies which know the field pretty intimately.

In other words, we have the feeling that we do not have the resources at the moment to do that detailed work. We can provide some co-ordination and support, and a context in which this work can be done. There needs to be detailed study field by field.

The Chairman: But at the moment there is no co-ordination in that field?

Dr. Dymond: No. I should not say there is no co-ordination because we do have a committee of associations and other people interested that has advised us on the conduct of that survey . . .

The Chairman: But that was for the purpose of advising you?

Dr. Dymond: Yes.

Senator Kinnear: Mr. Chairman, I should like to ask a question in respect of manpower at the other end of the scale from the highly skilled. A look at page 7 of the brief reminded me of the Adult Occupational Training Act, and I notice that you are able to provide 50 per cent of the cost of research in respect of occupational training. My question is: What research are you doing aside from this which you mentioned for the young dropouts that are not coming into the labour force, for the drifters and for what I call the escapists from reality, and also the welfare cases that remain on welfare year in and year out? Have you done any research on how you can bring these people into the manpower scheme? What percentage do you consider are in the lower scales?

Dr. Dymond: I think we have some research going on in respect of that, and I will ask Mr. Lachapelle to talk about the kinds of groups you are speaking about in the labour force—the people who are less competitive in respect to our labour force needs.

Senator Kinnear: Yes, but they are people who must be taken care of in some measure. I imagine Senator Thompson was asking questions along this line. How can you have them become useful and productive citizens. I know that a great many injustices are done to that class of persons, but they have to be taken care of in some way, and they have to try to find out the research work already done, or what you can do for people in these categories. I have mentioned. Also, I would like to know what can be done for the students in the summer. I know that this year is expected to be, like the last two, a very poor year for students to obtain work.

It is awfully glamorous to talk about the arts and the deep range of skills in the country, but we must also take care of the other end of the scale.

Dr. Dymond: I certainly agree, and much of the departmental programs are designed and focussed on the people with lower qualifications, the lower skills in the labour force, the people who need the most help in getting employment, who need retraining to get employment, who need access to our joint federal-provincial rehabilitation program to get employment.

We are doing some planning and have been doing some research in this area. We are planning, for example, a very detailed survey at the moment of the people who are registered for long periods in our Canada Manpower Centres, many of whom are in the kind of groups you are talking about, to find out just who these people are, to get a sense of what their problems are and what kinds of needs for programs they have. Dr. Campbell, could you enlarge a little on some of our work in this area?

Dr. Campbell: Yes, I would be glad to do so. In general, both our training and our mobility programs seem to be heading into groups that are very closely related to the groups you are talking about. A recent study that we did showed that about half the people getting into the training program in fact come from the poverty groups. One of the main vehicles that we have had so far for helping with the problems of drop-outs, people with low motivation, low skills and so on, has been the rehabilitation program. There we have a number of research projects, many of the action variety. For instance, we have a project which is being carried out by the Jewish Vocational Center in Toronto and which is concerned with conditioning techniques in regard to youth with low motivation, to get them to respond to society in a way that is more beneficial to them.

In regard to the summer job situation this is one that we have been very concerned about. For quite a number of years the department—and, before it, the National Employment Service—has conducted campaigns to find jobs for students. Last year, it became quite apparent that the normal sort of campaign simply would not be sufficient. What we did last summer was to increase greatly our advertising budget, to mount a special campaign. We hired well over a hundred students in our offices to help to organize and find employment for summer students. We will be doing the same thing this summer, on a much more intensive basis. We are also, I should say, looking into other ways of getting at this.

Senator Thompson: What about your “new start” programs?

Dr. Campbell: That is now with the department for regional development. Dr. Dymond is probably the person who can best describe that.

Dr. Dymond: That was focused on the disadvantaged in selected development areas, or designated areas, one in Prince Edward Island, one in Alberta, one in Saskatchewan and one in Nova Scotia. I think there is one going ahead in New Brunswick, and others are in the process of development. There are experimental pilot projects really designed to get at what can be done for the very disadvantaged people by way of all kinds of training programs. Much of it we feel needs to be focused on the family unit. You cannot bring the male breadwinner up to participate

more fully in the economy in our society unless you bring his wife up and other members of the family. It is basically an experimental project to turn up information about programs.

I might mention one other research program here. In co-operation with the provinces we are developing an extensive program of research on training, and many of the questions surrounding our Adult Occupational Training Act and related questions on training, guided by a committee of our deputy minister and the provincial deputy ministers of education and labour. This work will focus on a number of areas of research that they think are important and of high priority for the formulation of policy with respect to adult training.

One of the areas they have assigned considerable priority to is to look at the people not now being trained. Who are these people that we are not picking up, who are obviously candidates in some sense for employment in our economy? This concerns particularly the younger groups. There has been a lot of talk about the people we do not pay allowances to because they are not out of school long enough. What is happening to these people? Who are they? Hopefully from this research will evolve some method of dealing with people who are falling through the grates, so to speak, of our training programs particularly. I think that research will begin to impinge heavily on the kinds of questions you are raising.

Senator Kinnear: About what percentage would you think is in this group or these groups?

Dr. Dymond: We did some work on the disadvantaged group generally, people who are not competitive in a variety of senses. I do not have those figures in front of me. Perhaps Dr. Campbell can speak to this. It is principally the work of Joe Klein.

Dr. Campbell: It is a tremendously difficult area. We have had a number of studies within the department that are not listed here, because they were fairly brief. They concern the number of people who have severe employment handicaps, whether they are social or psychological, or a severe lack of education, discipline, whatever it may be. People have an enormous range of problems of this kind, such as mental retardation and so on. The number of people in the group who at one time or another experience severe difficulties is very difficult to estimate. We have different estimates, and you can get a figure anywhere between about 200,000 and 600,000 quite readily. It depends very much on how you define the group and what you presume to know their problems to be.

Not all these people, of course, have these problems in perpetuity—which is a blessing. The fact is that many of them, either through getting into a training program or, very frequently in the past—and

I imagine at the moment—through their own efforts, have managed to overcome their handicaps in considerable degree, so we do not necessarily have at any one moment of time 600,000 people who are in desperate need. However, over the course of a number of years you get very large volumes.

The Chairman: How do you think the research work should be divided between you, the Department of Regional Development and the Department of Health and Welfare? Surely the Department of Health and Welfare has an interest in this field too.

Senator Kinnear: It would with the disabled, of course.

Dr. Campbell: I think all three of those departments have a major interest and concern in it. Certainly the projects that have been carried on, as I mentioned, have been fairly small ad hoc projects intended to acquaint us with the general dimensions of the problem.

The Chairman: And, we know that the Department of National Health and Welfare is not doing very much in that field and probably we have not heard yet from the Department of Regional Development.

Dr. Campbell: Certainly, if we were contemplating a single major project what we would do would be to get together with those other departments and form a committee or working group to oversee the project as a whole. That is the sort of arrangement, I might say, that we have been using with increasing frequency. At the moment, for instance, we have a project that is being carried on by a number of university professors in British Columbia for us, on the problems of Indian mobility. This is a major problem in Canada. It is quite apparent that our mobility program is just not reaching as many Indians as we and the Department of Indian Affairs would like it to. Although, because of our interest in our program we are providing the financing for that project, we, at a very early stage, in the development of the project formed a committee with the Department of Indian Affairs. The committee oversees the project to make sure it is not useful just to us, but to Indian Affairs as well. That sort of arrangement is a very fruitful way of getting a research done, when you have more than one department with a substantial interest in it.

Senator Thompson: Are not many of these projects interrelated? I was looking at a film about people handicapped because of mental retardation, and they were receiving training through, I think, one of your projects with a province. I had the feeling that perhaps expectations are being raised in the minds of these students. This was expressed by some of them. Unfortunately, because of advanced changes in technology they will never realize this. It gives a serious question as to why we do not examine this further. There is ARDA and so many departments. I

would feel it is most essential to devote and examine these closely, but to be doing it on a co-operative basis there should be some departmental structure.

Dr. Campbell: That is very true. The problem has not arisen in all forceful terms. I think basically Dr. Dymond outlined the reasons earlier. There is considerable scarcity of research resources. We have not been competitive in the market for the upper skill ranges, financially.

The Chairman: Before you go on, who is responsible for this, the Treasury Board or the Public Service Commission?

Dr. Dymond: If I might tackle this one, Mr. Chairman, the problem relates to the classification of positions, which establishes the pay range. The pay range and the classification of positions is the responsibility of the Treasury Board. The Board bargains with the Public Service union that represents professionals in determining rates of pay. These days the Public Service Commission is primarily the recruitment agency of the Government.

Dr. Campbell: I think just on that specific point the sort of problem we are faced with is well illustrated by some of our recent experiences in our current recruiting campaign. A person with a brand new PhD and no experience at all, an individual writing his thesis can today become an assistant professor in a Canadian university at a salary, depending on the individual and the university, anywhere between \$11,000 and \$14,000 for a nine-month year. Now, while we do not have yet—

The Chairman: Plus a few research projects.

Dr. Campbell: Exactly. In the United States with a nine to ten-month academic year a survey showed that people in economics generally added 30 per cent to their academic salaries through contracts and research grants and things of that sort. Presumably that figure is higher in Canada because the academic year is somewhat shorter. If you take \$12,000 and add 30 to 40 per cent to that you have gotten up to, the rate we are in fact able to pay for experienced people who are carrying out a fair amount of administrative work as well. This simply makes it very difficult.

Senator Thompson: Well, I would like to go on record as saying that it seems to me to be a short-sighted policy on the part of Treasury that millions of dollars should be spent on projects in Manpower and Immigration while at the same time a large number of questions exist to which you could provide answers but you cannot because of limitations of professional staff.

The Chairman: The witnesses will be coming before us again.

Senator Carter: I have two unrelated questions. The first is a very simple one and follows on what Senator Kinnear was asking earlier concerning summer students. I think the question Senator Kinnear had in mind was with regard to the prospects for summer employment for students this year. Are they any better than they were last year?

Dr. Dymond: They are about the same, or perhaps a little worse than last year. There will be a few more people in the market but not too many more job opportunities as far as we can see.

Senator Carter: Then my second question has to do with the handicapped groups we were talking about earlier. I would like to know where responsibility lies for this. Maybe it is a provincial matter. But very often we have a group of people who are physically handicapped and who have no value on the ordinary labour market or in industry. At the same time you find in this group people who have tremendous talent; you find children who have a tremendous talent for painting and carving and all sorts of manual skills. Now unless they are discovered and receive proper training they can never be fully developed. Does your department take any responsibility for this? Do you find them and hand them over or point out to the provincial authorities, if it is their responsibility, that this is the situation? What happens in respect of groups like that?

Dr. Dymond: Well, there is the Vocational Rehabilitation Act, a federal act that provides for 50-50 cost-sharing and covers the rehabilitation of physically and otherwise handicapped individuals. Under this act payment is made for the process of vocational rehabilitation and medical rehabilitation, if it is required and cannot be covered by other schemes, and we refer people and the provinces refer people to this rehabilitation process. There are co-ordinators of rehabilitation in many provinces and there is machinery for identifying and placing people in the rehabilitation process under this federal provincial 50-50 cost-sharing arrangement.

Senator Carter: Do you have any machinery for discovering these people in the first place? Do you carry out research to ascertain how many there are?

Dr. Dymond: We were discussing this earlier, and it is very difficult to estimate the number. It would not be fair to say that we do not have any solid figures at the moment. So far as machinery is concerned, when our offices uncover people who have physical and other social handicaps who could be assisted by the federal-provincial rehabilitation process under the act, they will refer people to these rehabilitation

processes. Now, I would not want to claim that this is by any means complete or 100 per cent effective or anything like that. I think we are not necessarily doing an effective job on this front in Canada today, but there is a machinery and a mechanism. Part of the problem is that it requires a very skilled set of people to really diagnose the handicaps that people have. It requires quite often psychiatric skills, medical skills, social work skills and other skills, and it is to bring all of these kinds of skills to bear on an individual who has a whole complex of problems of a medical, psychiatric, social and economic character—that is the difficult thing to do from a diagnostic point of view. It is equally difficult to them to prescribe the appropriate course of rehabilitation and to bring together the various programs that will really do a job for the person.

Senator Thompson: How many social workers do you have in your employment staffs in the manpower offices?

Dr. Dymond: My impression is not too many. When we need these kinds of services, we tend to refer to agencies.

Senator Thompson: Do you have any involved as managers of offices or even as workers in offices?

Dr. Dymond: I think some of our counsellors have backgrounds in social work, but we are not hiring them as social workers.

The Chairman: I note from page 3 of your appendix that you make annual reports on the economic and employment outlook. Are you the only people involved in this kind of forecast?

Dr. Dymond: No. To my knowledge the main economic departments are all doing various kinds of economic forecasting. The Department of Finance does; the bank does, trade and commerce does. Our forecast, of course, is pitched primarily at employment, unemployment and the labour force in an economic context. In other words, the focus of our forecast is different from that of their forecasts.

The Chairman: Would it be done completely independently?

Dr. Dymond: No. While we do some independent work, we rely heavily on the work done in finance and trade and commerce and the bank in this area. Not that we accept it 100 per cent, but we do some very careful cross-checking with them and vice versa. So far as they are concerned, what they build into their forecasts on the employment, labour force, and immigration will tend to be the views that we come

up with, judged by their own independent assessment, of course.

The Chairman: Is this done through informal consultations or through a more systematic organization?

Dr. Dymond: Basically, it is done through informal consultations, although from time to time, usually under the chairmanship of an officer in finance, there will be an exchange of information on the economic outlook. But it is not in my experience a regular thing. It tends to be as often as finance wishes to check with other departments on the outlook.

The Chairman: On page 9 of the main brief there is a statement related to the Research Branch, where you say that the Research Branch carries out fundamental analyses of the functioning of the economy and the labour market, provided long- and short-range forecasts of manpower needs, and conducts research on departmental manpower and immigration programs. I suppose that this is a very general statement and does not mean that you intend to do research in all aspects of the functioning of the economy.

Dr. Dymond: No. We would not go any more deeply into the functioning of the economy than was necessary to understand the allocation process for manpower, the operation of the labour market, and so on. We tend to rely pretty heavily for that background on the work of other departments, the Economic Council and independent scholars. We would only go into it as required in relation to our fundamental emphasis on manpower, employment and the labour force.

The Chairman: So far as your actual program of research is concerned, in its relation to forecasts, you have not gone beyond 1975 yet.

Dr. Dymond: No. We have a project now, using pretty primitive methods, forecasting manpower requirements to 1975, projected largely for Canada and the regions for approximately 200 occupational classes.

Mr. Pankhurst: There are about 250 occupational classes in about 12 industrial divisions.

Dr. Dymond: I might say that we are giving some thought to the development of an econometric model for manpower forecasting, in consultation with the Economic Councils, DBS and other agencies. In other words, we would like to have a model we could constantly adapt as we have changing knowledge of the economic outlook and changing input relationships for manpower rather than con-

stantly redoing the job by projection methods. So, we are giving thought to some developmental work.

Senator Thompson: Are there any provinces doing a similar study?

Mr. Pankhurst: No.

Senator Thompson: They rely on you?

Dr. Dymond: I think Ontario did a study.

Mr. Pankhurst: They are not doing an econometric model; they are making some projections for the province.

Senator Thompson: When it gets down to the high school counsellor level, does he get this projection to advise young people about what sort of jobs to go into?

Dr. Dymond: He will, when we get it done. We have a study from 1965 to 1970. The Meltz-Penz study is being used in the meantime, and will be used fairly extensively.

The Chairman: 1970 is pretty short term now.

Dr. Dymond: Yes, that is why we call this other project the crash project, to get some information out by July, up to 1975.

Senator Bourget: Am I right in saying that the most important program you have developed and, possibly, the most costly, has been the adult occupational training program? Has this program been in operation long enough to find out exactly what are the beneficial results you get from it?

Dr. Dymond: I will turn that question over to Dr. Campbell, because he has been, in his branch, developing the benefit-cost model on this program, and we are going to feed some early statistical data into it.

Dr. Campbell: We have had developed, about a year ago, a benefit-cost model on that program. That model does not measure the benefits; it does measure the costs, and forecasts benefits. The only way to be truly precise about exactly what the benefits are is to follow the people up, get a precise reading, and feed it into the model. The preliminary results are highly favourable, on a forecast basis. We have had an extensive test of a questionnaire for a follow-up study and, depending on printing and associated problems, we hope to have a follow-up study going in the next two or three months which will provide the concrete data to see how big the benefits are. Preliminary indications are very good, but we will not know for certain until we have the tests.

Senator Bourget: What is the cost of that program per year?

Dr. Campbell: The budget, from my recollection—but I would want to check it—is about \$190 million.

Senator Bourget: And it is shared 50 per cent by the provinces?

Dr. Campbell: No, it is 100 per cent federal.

Dr. Dymond: That is the allowances cost and operating cost.

Senator Yuzyk: Have you a study of the placement of Bachelor of Arts graduates in universities, that is, their absorption into the labour force? I am asking this question because many of them have just a general arts degree and are not specifically qualified for specific jobs. Is there any study under way to gauge their absorption into the labour force?

Dr. Dymond: I might ask Mr. Pankhurst about that. There is some information from the highly qualified survey, but that would not catch the general arts people, would it?

Mr. Pankhurst: No.

Mr. Harry H. Morritt, Assistant Director, Manpower Information and Analysis Branch, Department of Manpower and Immigration: We have a survey of requirements for new graduates which will be carried out in March of this year, and this will give some indication of what our requirements are for this year for graduates in arts as well as in other fields.

Senator Yuzyk: But there is no study in respect of B. A. graduates and what happens to them after the leave?

Dr. Dymond: There is no study as to what happens to them after they graduate, but we would have some impressionistic information from the manpower centers on the university campuses—from their success in placing them. We get a reading from that kind of data, but there has been no detailed follow-through study.

Senator Yuzyk: Do you not think that your department should undertake some study in this area? This is a current problem every year.

Dr. Dymond: I would think it is certainly worth looking into because the labour market for university graduates may get more difficult in the future. I just do not have any very firm ideas on it, but we are approaching something of a peak in the inflow of university graduates into the labour force. It will peak in about 1973, I think, after which it will level

off to a much more gradual slope of increase after 1973. The rate of inflow will peak in about 1973, so that the next two or three years will be the more difficult years from an absorption point of view.

Senator Yuzyk: I have another question. Since the chairman has been associated with the Department of Citizenship in the past, or at least part of his department...

The Chairman: It is not there any more, though.

Senator Yuzyk: That is right. Is there any co-operation, or do you conduct any projects, with the Department of Citizenship?

Dr. Dymond: Yes, there has been consultation on this longitudinal study with the Department of Citizenship because they have an interest in the citizenship and social-cultural aspect of immigration. I think there is a project listed in the brief that studies the citizenship court records to get some information on the progress of immigrants. That has been worked out in some consultation with Citizenship. I think on the question of adjustment processes for immigrants—we have been giving some thought to the whole question of what is the non-immigrant's view of the immigrant—the view of the native Canadian or the immigrant who has been here for some time. We have not launched a study on this yet, but we have given it some consideration. If we go ahead with that kind of study then we would certainly do it in consultation and co-operation with Citizenship.

The Chairman: I do not think there is any duplication in research in this field, because we are told that the Citizenship branch of the Department of the Secretary of State does not do any research.

Senator Yuzyk: Perhaps it should be doing some.

Senator Thompson: Do you use a computer? I have a newspaper article here that is entitled "Computer Service Aim is to Match Jobless to Openings quickly". Has the classification of jobs across the nation ever been programmed on a computer so as to be able to fit people to the jobs?

Dr. Dymond: Right now we have a project—I do not think you could dignify it with the name "computer," but we are engaged in matching the vacancies against the clients, and we are doing it with mechanical equipment.

Dr. Campbell: We have been trying it primarily in the Prairie region with mechanical equipment, and we are now looking at the possibilities of actually having a computer-based match.

The Chairman: It has already been done in several areas of the United States.

Dr. Dymond: We are doing some mechanical matching and we are giving some attention to this.

The Chairman: It is already one o'clock and we will have to adjourn, although I am sure we could go on investigating the various areas of interesting research that you could do. We know that you are just at the beginning of this new venture in the Department of Immigration and Manpower, and we certainly hope that you have all the co-operation you need from various agencies, including the Treasury Board, in order to conduct your major operation with success. Thank you very much indeed.

The committee adjourned.

APPENDIX 29

SENATE OF CANADA

SPECIAL COMMITTEE ON SCIENCE POLICY

BRIEF

BY THE

DEPARTMENT OF MANPOWER AND IMMIGRATION

INTRODUCTION

The Department of Manpower and Immigration was formed on October 1, 1966. The new department was made up of the Immigration Branch of the former Department of Citizenship and Immigration, the manpower elements of the Department of Labour including the National Employment Service, and elements of the research and administrative support for manpower operations. The objective of the Department of Manpower and Immigration is to promote the effective allocation of manpower resources and the development of the labour force and its characteristics compatible with the maximum sustainable rate of economic growth of the Canadian economy.

The role of scientific activity within this Department is supportive of manpower policy development and operations. That is, the fundamental objectives of scientific research activity in the Department of Manpower and Immigration are to ensure that Departmental policies and programs are developed, planned and altered as necessary, to make the maximum contribution to the attainment of the Departmental goals, and that relevant data is collected and analyzed to support the Departmental operations.

Since the Department of Manpower and Immigration was not formed until October 1st, 1966, there will not be a great deal of completed research projects to report in this Brief. A considerable amount of the resources intended for research have necessarily been involved in organizing and planning the establishment of scientific activity in the Department.

A hindrance to the effective development of this activity has been the difficulties experienced in hiring and holding the highly qualified professional staff needed. It has been the Department's experience that the salary levels for senior research positions are not sufficiently attractive to permit the Department to hire, and hold, a sufficient number of researchers of the calibre required for the Department's planned research activities.

This Brief has been prepared in accordance with Part II of "Guide for Submissions of Briefs and Participation in Hearings" developed by the Special Committee on Science Policy of the Senate of Canada.

1. Organization

- a) Organizational block diagram of agency showing main units such as divisions and sections. Indicate those units conducting or funding scientific activities.

1. See Diagram 1(a). Conducting and funding of scientific activities is concentrated in the Program Development Service and its branches. Two other units in the Department have an indirect interest in research. Research on manpower adjustment within industry is paid for by the Manpower Division through the Manpower Consultative Service. The Staff Training and Development Task Force conducts a certain amount of action-oriented research on problems connected with the training and development of personnel, but it has no specific budget for this purpose.

- b) Block diagram, when appropriate or necessary, indicating Parliamentary reporting channel(s), formal connections to other Federal agencies, advisory committees, etc.

2. Diagram 1(b) shows the relationship of the Department of Manpower and Immigration to the Immigration Appeal Board, and to the Canada Manpower and Immigration Council and its related Advisory Boards.

3. The Immigration Appeal Board was established by the Immigration Appeal Board Act (1966-67, Ch. 90). The members of the Board are appointed by the Governor in Council and have a retirement age of 70. The function of the Board is to hear appeals both from the Minister, and from persons ordered deported and sponsors of would-be immigrants.

4. Establishment of the Canada Manpower and Immigration Council, its four Advisory Boards and, as required by the Minister on the advice of the Council, a system of Regional and Local Manpower Committees, was authorized by the Canada Manpower and Immigration Council Act (1967, Ch. 13). Members of the Council are to be appointed by the Governor in Council for a term of not more than three years but are eligible for re-appointment. The function of the Council is to advise the Minister on manpower and immigration matters.

5. Members of the four Advisory Boards are to be appointed by the Minister for not more than three years but are also eligible for re-appointment. The function of each Board is to consider and report to the Council on any matter within the Minister's responsibilities in relation to the specific field of interest of the particular Board.

6. The Regional and Local Manpower Committees may be appointed by the Minister, as required, on the advice of the Council, and will have the function of advising the Department in the person of the appropriate Regional Director or Area Manager in carrying out the functions of its manpower service.

c) Block diagram indicating the organization of units (e.g. divisions, sections, task forces, etc.) responsible for scientific activities.

7. See diagram 1(c).

d) Description of formal agreements regarding scientific activities between agency (or one of its units) with organizations outside of Canada including foreign governments or their agencies.

8. This Department does not have any formal agreements of the kind referred to. The Department does, however, co-operate with a number of agencies outside of Canada in various scientific activities.

9. This Department participates extensively in the following activities of the OECD:

- (i) Manpower and Social Affairs Committee
- (ii) Committee for Scientific and Technical Personnel.

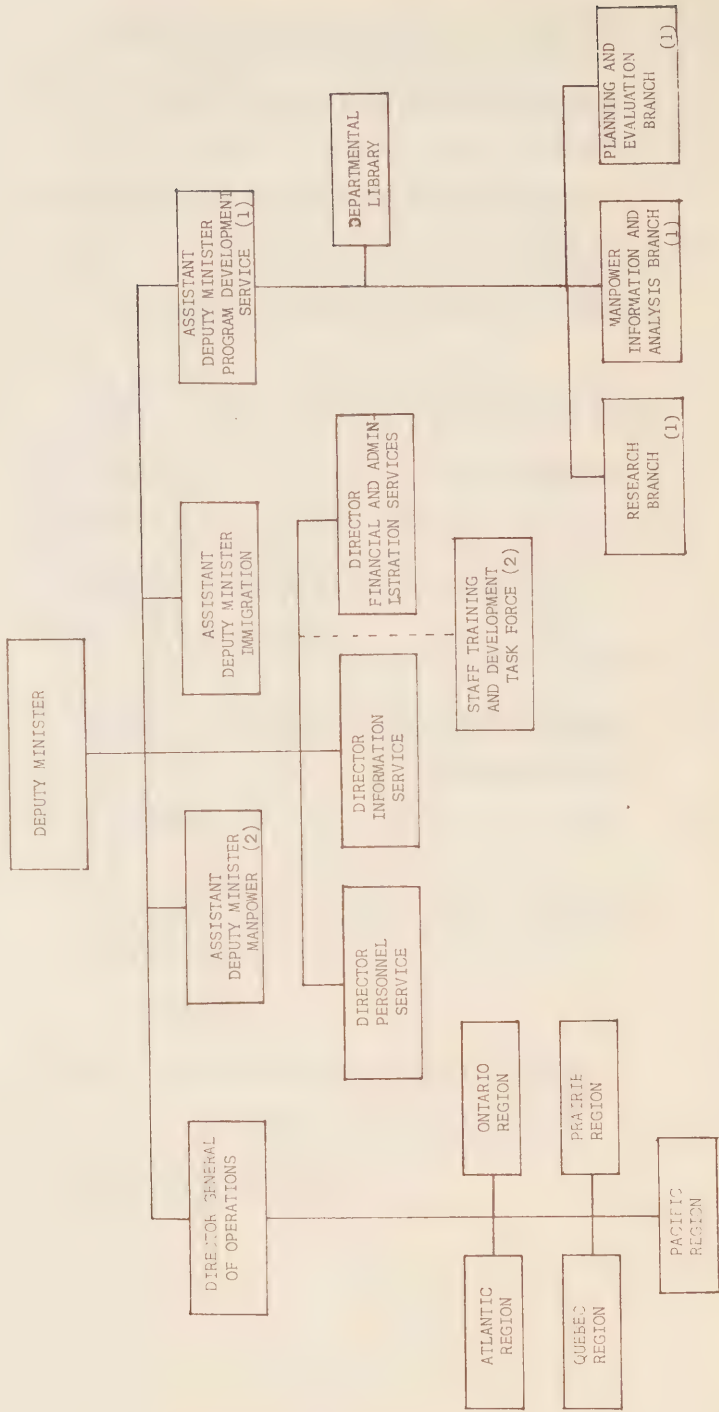
10. The Department is also involved in the ILO through our Department of Labour in matters related to manpower.

11. The Department is co-operating with the United States Department of Labour (i) by exchanging information on occupational research, and (ii) in sponsoring a North American Seminar on cost-benefit analysis as applied to manpower programs. The Department obtains information from the National Science Foundation on Canadian professional personnel working in the United States.

- e) Information concerning overseas offices of agency dealing with scientific affairs.

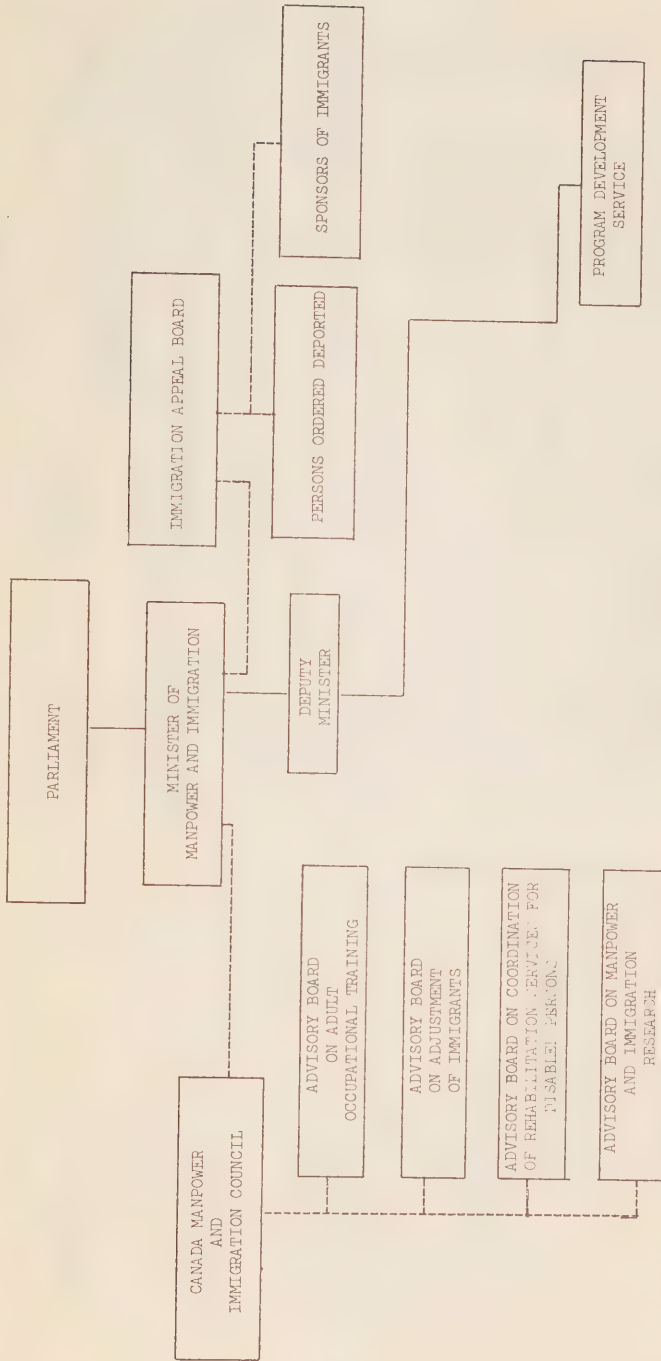
12. This Department has no offices of the kind described.

DIAGRAM I (a): ORGANIZATION OF THE DEPARTMENT OF MANPOWER AND IMMIGRATION



(1) Units concerned chiefly with scientific activities.
(2) Units for which scientific activities occur as a secondary interest.

DIAGRAM 1(b): FORMAL RELATIONSHIPS OF DEPARTMENT OF MANPOWER AND IMMIGRATION

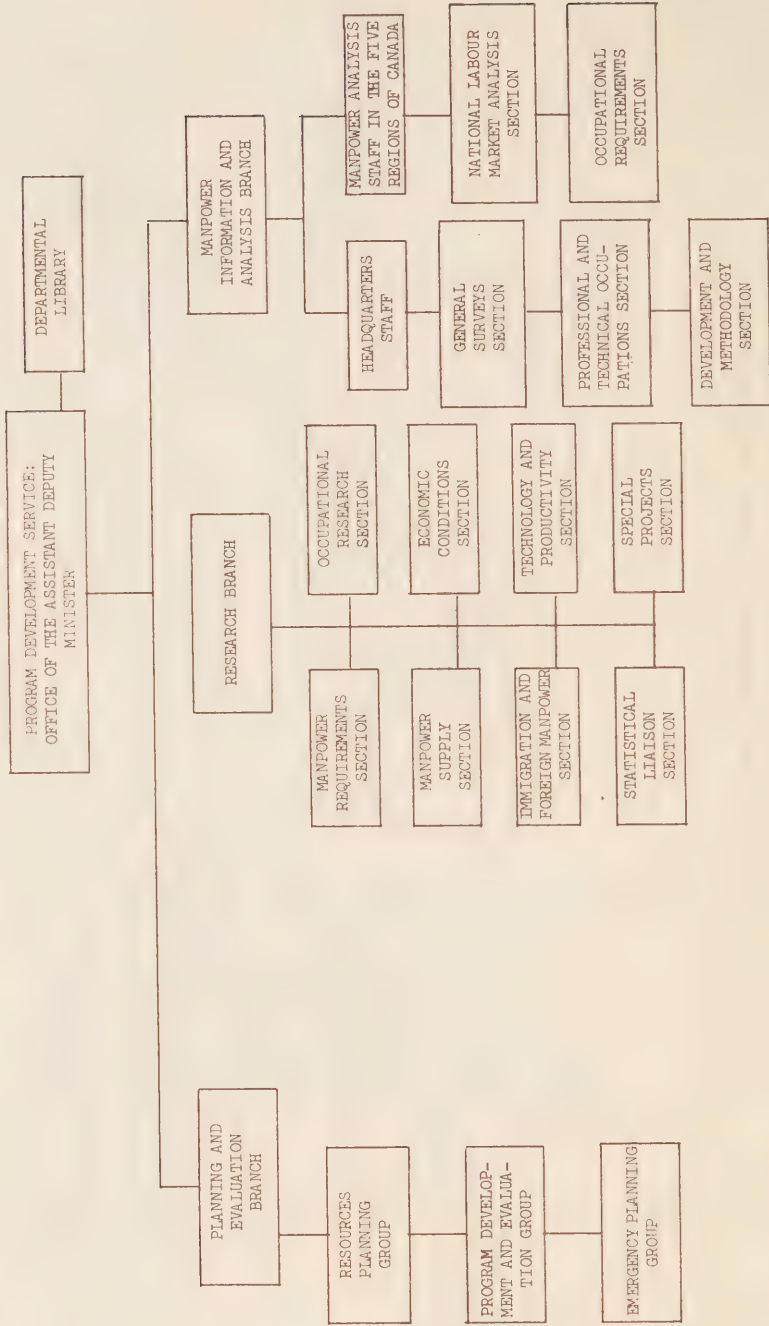


— Lines of Authority

----- Functional Relationships (advice, liaison appeals etc.)

DIAGRAM 1(c): ORGANIZATION OF SCIENTIFIC ACTIVITIES IN THE

DEPARTMENT OF MANPOWER AND IMMIGRATION



2. Organizational functions

a) What are the agency's statutory functions and powers regarding scientific activities?

13. The authority to carry on research on manpower problems is included in the blanket authority given to the Minister of Manpower and Immigration by the Government Organization Act (Statutes of Canada, 1966-67, Ch. 25). Section 13 of the Act is as follows:

"The duties, powers and functions of the Minister of Manpower and Immigration extend to and include all matters over which the Parliament of Canada has jurisdiction not by law assigned to any other department, branch or agency of the Government of Canada, relating to

"(a) the development and utilization of manpower resources in Canada;

"(b) employment services; and

"(c) immigration."

Within the overall limits thus established, the resources available for research activities authorized for each year are of course defined in more detail in the departmental estimates approved by Parliament for that year.

14. In addition to the broad functions and power conferred on the Minister by the Government Organization Act, specific authorization to conduct research in particular fields is given by two other acts:

(i) The Adult Occupational Training Act, (1966-67, Ch. 94, Section 10) authorizes the Minister, with the approval of the Governor in Council, to enter into an agreement with any province to provide for the payment by the Federal Government of up to 50 per cent of the costs of research in respect of occupational training, including the changing

manpower needs of the economy and the relation of these to training; and up to 50 per cent of the costs of projects for the development of occupational training courses.

(ii) The Vocational Rehabilitation of Disabled Persons Act (1960-61, Ch. 26, Section 6) authorizes the Minister to undertake research in respect of vocational rehabilitation for disabled persons; and to co-operate with any province in such research where he deems it appropriate; and to publish information relating to such research.

- b) What organizational policies have evolved (e.g. regarding the implementation of (a)) that could be considered to define your agency's "policy regarding science" or "science policy"?

15. The general science policy of the Department of Manpower and Immigration is that research is not directed primarily to the advancement of pure science. Its fundamental objectives are to ensure that departmental policies and programs are developed, planned and altered as necessary, to make the maximum contribution to the attainment of the departmental goals, and to provide information and analyses vital to the effective operation of discretionary programs.

16. The Program Development Service of the Department pursues these objectives by:

- (i) analyzing the public need for policies and programs and determining the degree of need for new programs or program changes;
- (ii) initiating and co-ordinating long-term program planning and conducting program analysis of the courses of action available to reach the departmental goals;
- (iii) evaluating the impact, costs and benefits of existing departmental activities and sub-activities and recommending changes therein;

- (iv) analyzing those recommendations concerning departmental policies and programs which emanate from the Canada Manpower and Immigration Advisory Council and Boards and domestic and international organizations;
- (v) providing detailed, prompt, specialized and accurate labour market information, analyses and research as a basis for departmental decisions on the purchase of training courses, the admission of immigrants, referral and mobility, and providing needed analyses to organizations and individuals to assist their decision making;
- (vi) providing co-ordination with other federal departments and provincial governments in the above areas.

17. These functions are performed by the Program Development Service through three branches as follows:

- (i) The Planning and Evaluation Branch assists in the development of departmental policies and programs, undertakes long-range planning, and evaluates the impact, costs and benefits of operating programs and potential alternatives.
- (ii) The Research Branch carries out fundamental analyses of the functioning of the economy and the labour market, provides long- and short-range forecasts of manpower needs, and conducts research on departmental manpower and immigration programs. It also is producing a Canadian Classification and Dictionary of Occupations in co-operation with DBS for statistical and operating use of all government and other agencies in Canada.
- (iii) The Manpower Information and Analysis Branch provides the information on, and analyses of, current and short-term future manpower and labour market conditions for use by the Department and outside agencies and individuals.

18. Urgent needs for research on many problems arise from the requirement for more adequate information in order to develop the Department's policies for action on such important matters as adult occupational training, manpower mobility, immigration, rehabilitation, etc. In order to utilize the available resources of scientific manpower as fully as possible to meet these urgent needs, it has been found advisable to rely to a great extent on the encouragement of extramural research, by government financial assistance through research grants and the contracting-out of specific projects.

19. The research authorized by the Adult Occupational Training Act is carried on, in accordance with the provisions of the Act, under agreements which have been signed with all ten provinces; the costs of research projects being shared equally between the province and the Federal Government.

c) Taking (a) and (b) into account, briefly describe the organization's functions and responsibilities in relation to:

- i) other Federal agencies
- ii) industry
- iii) educational institutions
- iv) international representation and the monitoring of scientific activities outside of Canada
- v) other

and describe the process whereby these are achieved or honoured, citing cases-in-point if appropriate or necessary.

i) Other Federal Agencies

20. Other Federal agencies such as Industry, Trade and Commerce, Bank of Canada and Finance, are able to benefit by the results of the research of the Department of Manpower and Immigration. These results include, for example, current data on manpower demand and supply in the national, regional and local labour markets; information on the demand for, and supplies of, professional and highly-qualified personnel; projections of the labour force, of

manpower requirements, and of the demand for highly-qualified personnel; current statistics on immigration; studies of problems in the adjustment of immigrants to life in Canada, and of conditions abroad affecting the movement of immigrants to Canada; and the Canadian Classification and Dictionary of Occupations which is being prepared. The principal results of such research are available, or will be available, in printed reports, either periodical or special.

21. Examples of more specific research services performed in large part for the use of another agency are: Assistance in the designation and delimitation of boundaries of areas to be assisted by the Area Development Agency; and evaluation of programs of relocation of Indians administered by the Department partly on behalf of the Department of Indian Affairs and Northern Development.

22. Services by other agencies to the Department of Manpower and Immigration include the provision of a variety of statistical data by the Dominion Bureau of Statistics, with which frequent liaison is maintained. An important current example of such co-operation is in the planning and discussion of the Canadian Classification and Dictionary of Occupations. The Department also has a formal contract with the Dominion Bureau of Statistics in regard to the newly-developed Survey of Job Vacancies, which is financed by the Department and conducted by the Bureau, according to plans prepared jointly.

23. Certain other Federal agencies have particularly important interests in common with the Department of Manpower and Immigration. These include the Department of Labour, the Department of Forestry and Rural Development, the Indian Affairs Branch, and the Citizenship Branch of the Secretary of State Department. The obvious danger of duplication of research is avoided chiefly by informal discussion

and correspondence between this Department and the others. In cases where joint interests are substantial, the research is frequently guided by an ad hoc committee and funds are jointly provided. A further check is provided by the overall Treasury Board surveillance.

(ii) Industry

24. Industry can benefit from the published results of research carried on in the Department. On the other hand, information is frequently obtained from employers in the course of research in various fields. The most important current example of the latter relationship is the gathering from industry of large numbers of job descriptions by the Occupational Research Section of the Research Branch, for use in the preparation of the forthcoming Canadian Classification and Dictionary of Occupations.

(iii) Educational Institutions

25. Educational institutions, including universities, secondary schools and institutions for technical and vocational training, can benefit from the results of research on manpower, including forecasts of future manpower requirements, especially requirements for professional and other highly-qualified manpower. Descriptive monographs which are prepared on a large number of skilled and professional occupations, are used in schools to assist vocational guidance; the Canadian Classification and Dictionary of Occupations will probably become an important reference work for this purpose.

26. Departmental personnel who are planning research projects frequently consult professors and other members of the staff of educational institutions, to the benefit of both parties. This, of course, is usually an informal relationship between individual research workers, rather than a formal relationship between the institutions which employ them.

27. Arrangements for the performance of extramural research may take the form of grants by the Department, or of contracts given by the Department to educational institutions for research to be undertaken by professors or students. On occasion, formal arrangements are made between the Department and the research workers concerned. In these cases, the educational institution itself may not be formally involved, except in granting leave of absence to the research worker if necessary.

(iv) International Representation

28. International relationships have been covered in Section 1(d).

(v) Other

29. Other relationships include certain relationships with provincial governments and with organizations representing various special groups.

30. The most important formal relationships with the provincial governments, in connection with research, are the agreements signed with all ten provinces under the terms of the Adult Occupational Training Act of 1967 (Section 10). By these agreements, the Federal Government will pay 50 per cent of the costs incurred by the province for research projects such as are described in the Act, i.e.,

(a) research in respect of occupational training including research in respect of the changing needs of the economy for trained workers, and (b) projects for the development of occupational training courses and materials for such courses. Such research projects must have the prior approval of the Minister of Manpower and Immigration, to whom the province must submit a detailed description of the project beforehand. A ceiling of \$500,000 per year is placed on the money to be paid out by the Federal Government under these agreements.

31. There are less formal relationships with various provincial agencies by some sections in connection with research in various fields. The Occupational Research Section, for example, makes contacts with provincial departments of education, of economic development, etc., both to obtain research data and to impart the results of research. The field staff of the Manpower Information and Analysis Branch maintain regular liaison with provincial agencies concerned with manpower problems.

32. Organizations representing special groups in the population have formal or semi-formal relationships with the Department in several ways.

33. The Minister, in selecting members for the four Advisory Boards established under the Canada Manpower and Immigration Council Act, 1967, to advise the Canada Manpower and Immigration Council, is instructed to consult such representative organizations as he deems appropriate in each case. One of the boards involved is the Advisory Board on Manpower and Immigration Research.

34. Organizations representing disadvantaged groups are frequently consulted about the planning of research connected with such groups. Disadvantaged groups include, for example, the blind, the deaf, the retarded, the mentally ill, and other groups suffering from handicaps; adults with low educational levels; and Indians and Eskimos.

35. Professional associations representing, e.g. engineers, physical scientists, sociologists, economists, etc., are called on for assistance in maintaining as complete as possible a register of personnel employed in such professions in Canada. A survey of such personnel is carried out periodically by the Manpower Information and Analysis Branch, to provide statistical data for research on highly-qualified personnel.

- d) Describe the process whereby your operational effectiveness, duties and goals are reviewed and revised.

36. These objectives are pursued through the Department's Program Planning and Review Process. This is an annual procedure through which the Department's programs of future activities are reviewed and revised and on this basis the estimates for the coming fiscal year are prepared. This procedure has been developed as a result of the effort by the Department to apply the Glasco Commission's recommendation of Program Budgeting, and a related effort to apply cost-benefit analysis to the planning of its programs, in both of which efforts the Department of Manpower and Immigration has taken a leading role.

37. The operation of the Program Planning and Review Process may be illustrated by the procedures scheduled to be followed in preparing the programs and estimates for the 1970-71 fiscal year. These procedures have the following stages:

- (i) Views as to the main unresolved issues facing the Department are collected from the staff, and are refined into major "issues", on which our program analysts prepare papers.
- (ii) The Planning and Evaluation Branch of the Program Development Service, which is responsible for the Program Planning and Review, prepares a presentation to the Senior Management Committee on the resource implications of decisions on the "Issues", together with the resource implications of alternatives.
- (iii) The Senior Management Committee (which includes the Deputy Minister and the other senior officials of the Department) meets in January, 1969, to review the alternative resource allocations and to recommend to the Minister those allocations and resource levels which seem realistic and likely to produce the greatest economic benefit.

- (iv) On the basis of these decisions, the annual Program Review document, embodying forecasts of programs and expenditures for the next five years, is prepared and submitted to the Treasury Board in May.
- (v) The Treasury Board provides the Department with targets for its estimates based on the Program Review.
- (vi) Based on these estimates, detailed one-year operational plans are prepared for the fiscal year 1970-71.

38. By following this procedure, the Department is annually reviewing its program of activities for the ensuing five years, and within this longer-run schedule prepares detailed operational plans for the next year, representing the best use of the available resources.

39. It must be noted that the research programs of the Department are subjected to the same process of annual review as the Department's operational programs. The Program Development Service is responsible for reviewing its own programs as well as those of other parts of the Department.

40. This does not mean that research programs are reviewed only once a year. Between the annual program reviews, each research program is subject, by the nature of research, to constant consideration, discussion, and amendment within the limits of the resources allocated to it.

e) Describe any outside studies commissioned (during the last five years) to suggest improvements of agency's operating procedures.

41. Since the Department of Manpower and Immigration was established in 1966, the following outside studies, each of which has some relation to research, have been commissioned and completed.

(i) Operations Research Incorporated in 1967 made a cost-benefit study of the Occupational Training of Adults Program. This study was not directed at the improvement of research operations in the Department, but was nevertheless of great interest to research workers in the Department because it introduced them to methods of cost-benefit analysis, which can be applied in other fields in the future. This study was financed jointly by the Department and the Treasury Board.

(ii) More recently, a study of an information system for the Department has been carried out by a task force staffed by the Department and by Operations Research Industries. The objective of this study was to develop a system to produce all the information required by the Department for its operations and the program planning and budgeting process. In this case, also, the value of the study to research was a by-product rather than the chief purpose of the study.

(iii) Professor N. Meltz of the University of Toronto carried out a study in 1967 of the requirements for labour market information of the Department and of other users; and of the extent to which such requirements are satisfied, or could be satisfied, by the Department's own operations. The final report of the study presented a program, including some research projects, through which the Department might improve its provision of labour market information.

f) Comment on the relationship between the agency's responsibilities and powers, and its activities and programmes.

42. As has been stated above, research in the Department of Manpower and Immigration is directed at the improvement of the operational programs of the Department. While some government departments may encourage researchers in their general fields of interest, this Department carries on research intramurally, or grants money for extramural research projects, primarily to directly help the Department meet its program objectives.

g) What have been, what are currently, and what do you foresee as being the major hindrances to the effective performance of your functions, the honouring of your responsibilities and powers?

43. The chief hindrance, both current and foreseeable, is shortage of qualified staff to perform the research functions required. A substantial number of the research positions established in the Department have remained vacant, because of such conditions as the inadequate salary levels offered and a general shortage of adequately qualified personnel in certain fields, such as cost-benefit analysis.

44. The other major hindrance to effective scientific activity is the necessity to conform to procedures of budgeting, financial and personnel control primarily adapted to a large operating organization.

h) What major changes in organization functions are forecast as probable or desirable during the next five years?

45. The Department is still in an early stage of its development; changes are expected as the needs for various functions become increasingly clarified. However, it is difficult to forecast the nature of these changes except in very broad terms. One change which is just now taking place is the development of a training Research Branch to carry out the major research effort needed to make the Occupational Training of Adults Program most effective.

3. Personnel Policies

- a) What steps are taken to identify and hire those members of university graduating classes who will be the most effective researchers for your organization?

46. Personnel are recruited through the normal system of competitions of the Public Service Commission. Because of the shortage of adequately qualified research workers, and because of the unusually large number of vacant positions to be filled in the Department of Manpower and Immigration, every effort has been made by the Department to assist the recruitment process, by such methods as the preparation of material for inclusion in information booklets for circulation to students, and the assignment of research personnel from the Department to serve as members of recruitment teams sent by the Public Service Commission to interview job applicants in various parts of Canada and in other countries. Individuals suitable for recruitment are also discovered through informal contacts with university professors and other persons engaged in research in the manpower field or in related fields, in other government agencies or in private employment.

47. It should be added that recruiting efforts are not confined to the members of university graduating classes. On the contrary, the shortage of more experienced, more highly qualified research workers is a more serious problem than the need to recruit recent graduates from universities.

- b) Have any unique criteria been developed (or any research initiated to develop criteria) to help identify those who will be creative and effective researchers?

48. No unique criteria have been developed. However, when considering members of a university graduating class for research positions, we always examine carefully their research activities at

university. Most, if not all, of these people have completed at least one graduate degree and can produce their theses and publications as evidence of research ability. These results are discussed with them and with the faculty members under whom the research was carried out.

c) What steps are taken to identify those members of the staff with high potentiality as research administrators?

49. Potential for research administration can be identified in staff members through the regular management and supervision of research projects.

50. Potential for research administration, identified through this process can be tested by assigning the employee as team leader on a short-term research project.

d) What distinctions are made between administrators of research and researchers as such; for example, regarding promotion, salaries, etc.?

51. The main distinction between administrators of research and researchers is the higher classification levels for the former group. Research administrators are usually paid the salaries of the top level of their occupational group or of one of the levels of the Executive Category, while a researcher's level is limited by the level of the research administrator managing his unit. This often makes it very difficult to hire highly-qualified research personnel, since to be able to offer them a reasonable salary, the manager must also assign them administrative functions which reduces their time for and effectiveness in research. Also, the promotion

of a researcher while based primarily on the effectiveness and quality of his research methods up to a certain medium range level, is limited beyond that, despite his work, by the extent of the administrative burden he takes on. The promotion of a research administrator usually is based on a significant increase in his administrative responsibilities (i.e., an enlarged area of research and a staff increase on transfer to a more responsible position).

- e) What is the policy regarding intramural and extramural education for staff members conducting or administering research?

52. The policy which governs extramural education for research staff is defined by Treasury Board regulations as follows:

- (i) Educational leave without pay for a period not in excess of three years may be granted to an employee by a deputy head under Section 57 of the Public Service Terms and Conditions of Employment Regulations.
- (ii) Reimbursement of 50% of tuition fees for successfully completed evening or correspondence courses related to the employee's work was permitted by Treasury Board Minute T.B. 620135, March 6, 1964.
- (iii) Attendance at courses or conferences to familiarize an employee with changes or trends in his field of work, and payment of tuition or registration fees, and travelling, living and other necessary expenses, within certain strict limits of time, expense, etc., is permitted under T.B. 524534, amended by T.B. 635548 and T.B. 642580. Beyond the limits thus stated, the granting of leave and payment of expenses for an employee sent on a training course requires Treasury Board approval (T.B. 546465, June 17, 1959).

53. There is no general policy regarding intramural education programs in the research and development areas of the Department. However, some sections provide intramural training for their personnel in specific types of work. The Occupational Research Section of the Research Branch holds seminars to train its personnel in occupational classifications and related techniques. The Manpower Requirements Section of the Research Branch gives on-the-job training in statistical techniques to its staff as required. The Manpower Information and Analysis Branch has an extensive training program for its regional analyst staff.

4. Distribution of Activities

54. The expenditure of funds on research in the different regions of Canada is governed by three factors. First, the Manpower Information and Analysis Branch has professional staff in each of the five regions of the Department's operations to collect and analyze on a regional and local basis data on the current labour market. Secondly, the Department carries out, or supports, some studies on regional or local problems related to the labour market. Thirdly, extramural research, even when its purpose is not regional, is often carried out outside of Ottawa; the governing factor being where the research talent is available.

a) The regional pattern of agency's spending (intramural and extramural) on scientific activities (e.g. by province).

55. In 1968-69, it is estimated that the field portion of the Manpower Information and Analysis Branch budget will be apportioned between the five regions approximately as follows:

Atlantic	-	13%
Quebec	-	31%
Ontario	-	27%
Prairie	-	17%
Pacific	-	12%

56. Extramural research, including grants and contracts, this year will likely be distributed between the five regions approximately as follows:

Atlantic	-	4%
Quebec	-	30%
Ontario	-	63%
Prairie	-	2%
Pacific	-	1%

b) The regions, if any, particularly suited for certain scientific activities.

57. The distribution of funds for the Manpower Information and Analysis Branch field data collection is determined by the size of the labour market involved.

58. The distribution of extramural research funds is largely determined by the availability of research talent. Thus, Ontario and Quebec receive much more of these funds since there are considerably more universities, research institutions, and other facilities for social science research in those two regions.

c) Activities carried out, on an annual basis during the last five years, to assist in the investigation of regional problems or phenomena.

59. The Manpower Information and Analysis Branch continually collects and analyzes current data related to the local and regional labour market, i.e. occupational shortages and surpluses. The Research Branch has undertaken studies of manpower mobility, mostly through contracts or grants.

d) The role of your agency in contributing to regional development.

60. In a research sense, this Department is not heavily involved in contributing to regional development. Of course, the operating programs do have a significant effect on regional development, and hence the research which supports them has an effect.

e) In your experience, the cost and benefits of regional distribution of your scientific activities and the necessary conditions for this distribution to contribute to regional development.

61. There have been no evaluations which would contribute to answering this question.

5. Personnel associated with scientific activities

62. The following fourteen tables give the information requested for the Program Development Service of the Department of Manpower and Immigration, and when available, for the four branches which at present make up this service. These four Branches are:

Planning and Evaluation

Research

Manpower Information and Analysis

Administration

Except for figures applying to earlier years, the statistics are all for the date of October 1, 1968. Since the Department of Manpower and Immigration began to operate only at the beginning of 1966, there are no statistics for earlier years.

Table 5(a). Current personnel establishment and people on strength by category of personnel: Program Development Service, Department of Manpower and Immigration, October 1, 1968

Category of Personnel	Number of positions on establishment by branch					Number of persons on strength by branch				
	Planning and Evaluation	Research	Manpower Information & Analysis	Administration	Total four Branches	Planning and Evaluation	Research	Manpower Information & Analysis	Administration	Total four Branches
Senior Officers and Senior Economists	1	2	1	1	5	-	2	1	1	4
Administrative Services	3	3	9	2	17	2	3	7	2	14
Administrative Support (Clerical & Secretarial)	12	27	37	5	81	5	12	35	4	56
Program Administration	5	55(a)	5	1	66	4	50	3	-	57
Economists	8	34	66	-	108	4	15	53	-	72
Statisticians	1	2	22	-	25	1	2	14	-	17
Sociologists	-	4	1	-	5	-	2	1	-	3
Unclassified	3	5	24	2	34(b)	-	-	-	-	-

Note: Categories of personnel by occupation are those in force at the date of October 1, 1968. There were no guest workers, staff-on-loan, or post-doctorate fellows in these branches.

(a) Most of the Program Administrators in the Research Branch are occupational analysts on the Canadian Classification and Dictionary of Occupations project.

(b) Unclassified by the Bureau of Classification Revision Division of the Treasury Board.

Table 5(b). Number of above professional staff
devoting most of their time to research administrative duties

Planning and Evaluation Branch	1
Research Branch	6
Manpower Information and Analysis Branch	13
Administration	1

Table 5(c)(i). Country of birth of professional personnel

(Number of persons by branch and highest university degree)

Country of birth	Planning and Evaluation			Research			Manpower Information and Analysis			Administration			Total four Branches			
	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	Ph.D.
Canada	4	1		14	7	3	24	7		1			43	15	4	
United Kingdom	1			3			2	2					6	2		
Austria						1		1						1	1	
Bolivia																
China				1		1							1		1	1
Czechoslovakia				1		1							1		1	1
Egypt						1	1		1							
France																
Germany	1				1			1					1	2		
India																
Nepal				1				1					1	1		
Netherlands																
Poland					1									1		1
USSR						1										
West Indies				1			1						1			
Yugoslavia				1									2			

Table 5(c)(ii). Country in which secondary education taken by professional personnel

(Number of persons by Branch and highest university degree)

Country in which secondary education taken	Planning and Evaluation			Research			Manpower Information and Analysis			Administration			Total four Branches		
	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.
Canada	4	1		17	7	4	24	7		1		1	46	15	5
United Kingdom	1			2			3	2					6	2	
Austria				1		1							1		1
Belgium															
Bolivia						1		1					1		1
China						1									
Czechoslovakia				1		1			1				1		1
Egypt															1
France				1		1							1		1
Hong Kong															
India	1				1			2					1	3	
Italy							1						1	1	
Pakistan															
Poland	1				1								1	1	
West Indies				1									1		
Yugoslavia							1						1		

Note: Total persons with B.A. in this table exceed the total in the preceding table, because a few of these persons took secondary education in more than one country.

Table 5(c)(iii). Country in which highest university degree taken by professional personnel

(Number of persons by Branch and highest university degree)

Country in which highest degree taken	Planning and Evaluation			Research			Manpower Information and Analysis			Administration			Total four Branches		
	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.
Canada United Kingdom	5 1	1		18 3	6 1	1	27 1	7 4		1			51 5	14 5	1
United States Denmark				1	1	4 1		1				1	1	2	5 1
France Switzerland					1	1 1			1					1	1 2

Table 5(c) (iv). Number of working years since graduation and number of years employed in present organization
(Number of persons by Branch and highest university degree)

	Planning and Evaluation			Research			Manpower Information and Analysis			Administration			Total four Branches		
	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.	B.A.	M.A.	Ph.D.
Number of working years since graduation:															
0 to 4	3	-	-	11	3	2	15	8	1	1	-	-	30	11	3
5 to 9	-	-	-	2	1	3	3	2	-	-	-	-	5	3	3
10 to 19	3	1	-	4	3	2	6	1	-	-	-	1	13	5	3
20 and over	-	-	-	5	2	1	4	1	-	-	-	-	9	3	1
Number of years employed in present organization:															
under one	-	-	-	1	1	2	12	6	1	-	-	-	13	7	3
one and under two	1	-	-	4	3	2	10	5	-	-	-	-	15	8	2
two and over	5	1	-	17	5	4	6	1	-	1	-	1	29	7	5

Table 5(c)(v). Average age of professional personnel

	<u>B.A.</u>	<u>M.A.</u>	<u>Ph.D.</u>
Planning and Evaluation Branch	31	37	-
Research Branch	36	38	40
Manpower Information and Analysis Branch	32	31	29
Administration Branch	25	-	47

Table 5(c)(vi). Percentage of professional personnel able to operate effectively in Canada's two official languages

	<u>B.A.</u>	<u>M.A.</u>	<u>Ph.D.</u>
Planning and Evaluation Branch	Nil	Nil	Nil
Research Branch	30%	50%	50%
Manpower Information and Analysis Branch	21%	58%	100%
Administration Branch	Nil	-	Nil

Table 5(d). Total number of professional staff in each degree category, Program Development Service, 1966 to 1968

	<u>B.A.</u>	<u>M.A.</u>	<u>Ph.D.</u>
1966	26	7	5
1967	41	13	7
1968	57	22	10

Table 5(e). Percentage of turnover of professional staff, Program Development Service, 1966 and 1967

	<u>B.A.</u>	<u>M.A.</u>	<u>Ph.D.</u>
1966	12%	14%	20%
1967	12%	15%	28%

Note: Percentage of turnover =

$$\frac{\text{Number of separations in year}}{\text{Total professional staff}} \times 100$$

Table 5(f). Percentage of current professional staff who, since graduation, have been in various types of employment

(Percentage of personnel by Branch)

Employment	Planning and Evaluation	Research	Manpower Information & Analysis	Adminis- tration	Total four branches
	%	%	%	%	%
By industry	Nil	53.8	26.8	Nil	36.3
On staff of universities	Nil	17.9	14.6	50	15.9
By provincial depts. or agencies	13.3	12.8	9.6	Nil	11.3
By other federal agencies	85.7	46.1	36.5	100	45.4

Table 5(g). Number of staff in each degree category on educational leave:

One M.A. in Manpower Information and
Analysis Branch

One B.A. in Administration

Table 5(h). Number of university students given summer employment in the field of scientific activities in the Program Development Service for the years 1966 to 1968

1966	6
1967	30
1968	14

6. Expenditures Associated with Scientific Activities

a) The following tables give the total funds spent by the Department of Manpower and Immigration, broken down in the following categories:

Table 6 - a - Functions

Table 6 - b - Scientific discipline

63. The data given refers only to the fiscal years beginning 1966-67, which is the year the Department was formed. Drastic changes in proportions between functions and between scientific disciplines can be accounted for between 1966-67 and 1967-68 by the formation and expansion of new research capacities and between 1967-68 and 1968-69 by the removal of the Pilot Projects Branch which was transferred to the Department of Forestry and Rural Development.

Table 6 - a

Department of Manpower and Immigration

Actual and Estimated Research Funds by Function

	<u>\$,000's</u>		
	<u>1966-67</u>	<u>1967-68</u>	<u>1968-69</u>
Intramural Research and Development	849	6,287	4,633
Data Collection	-	577	1,514
Total	<u>849</u>	<u>6,864</u>	<u>6,147</u>

Table 6 - b

Department of Manpower and Immigration

Actual and Estimated Research Funds by Scientific Discipline

	<u>\$,000's</u>		
	<u>1966-67</u>	<u>1967-68</u>	<u>1968-69</u>
Demography	149	1,075	460
Economics	545	2,420	5,167
Psychology	-	1,529	41
Sociology	<u>155</u>	<u>1,840</u>	<u>479</u>
Total	<u>849</u>	<u>6,864</u>	<u>6,147</u>

64. All research in this department is primarily meant for application to national economic manpower policy and operations. Some of the results are secondarily useful in fields such as regional development, social policy, and educational techniques and policies. It would be extremely difficult, however, to assign dollar values to the proportion of the research which is useful in this secondary sense.

- b) Table 6 - c gives the actual and estimated operating and capital funds for the units described in 1 (c) for the fiscal years 1966-67 to 1969-70.

Table 6 - c

Department of Manpower and Immigration

Actual and Estimated Operating and Capital Funds of Units

Primarily Concerned with Research

	<u>\$,000's</u>		
	<u>1966-67</u>	<u>1967-68</u>	<u>1968-69</u>
Program Development Service Administration	-	173	396
Pilot Projects Branch	-	3,727	-
Planning and Evaluation Branch	-	253	381
Research Branch	747	1,209	2,241
Manpower Information and Analysis Branch	-	1,155	3,029
Manpower Consultative Service	87	46	100
Manpower Grants	15	301	-
Total	<u>849</u>	<u>6,864</u>	<u>6,147</u>

- 6 - c In 1967-68, the Department spent \$7,415 in furthering professional education at university for departmental staff. In 1968-69, the expenditure will be about \$4,000 for this purpose.

7. Research Policiesa) Units Concerned with Intramural Research Activities(1) Process Whereby Various Types of Programs and Projects are Selected, Initiated and Monitored.

65. In general, as with all departmental activities, this process is handled through the program review and estimates procedure as described in Section 2 d). Possible research projects related to departmental programs, policies or issues are outlined and their resource implications described. Priorities between projects are then established within the resource limitations. Decisions are made on the best methods of carrying out the research (intramurally or under contract) and a detailed operational plan for each project is prepared. This program of research is annually reviewed, and also is subject to adjustment should departmental priorities shift. Research progress is evaluated against the operational plan and appropriate adjustment in financial and manpower resource allocation is made.

66. The Planning and Evaluation Branch is primarily involved in evaluation or analysis of operating programs in terms of their effectiveness in meeting their objectives and development of new programs. Therefore, the initiation of virtually all projects is internal to the department, the principal parts of the department that play a role being the Deputy Minister's office, the senior management of the operating divisions and the Assistant Deputy Minister of Program Development.

67. In the Manpower Information and Analysis Branch the program activities are primarily responses to the department's need for analysed data for operational purposes. New projects would be in response to an informational need, involving the development of the techniques of collection and analysis of the required information, and then the actual carrying out of this collection and analysis.

68. In the Research Branch each section deals with different aspects of manpower economics and, therefore, the source of new issues for research involves not only the Department but also other federal

agencies and other bodies.

(2) Establishment of Priorities

69. The process of establishing research priorities in this department has already been partially described in the section above. Briefly, research priorities reflect the operating priorities of the department, departmental policy regarding possible future activity, and the state of knowledge in these areas. Research needs are ranked and compared to resources available. With this information the priorities are set.

(3) Network Methods.

70. Some research projects of the department do make use of either the critical path network or Program Evaluation and Review Technique (PERT). Two outstanding examples in the department of this are the Pilot Projects Branch which used PERT techniques to lay out the process of establishing itself, and the Canadian Classification and Dictionary of Occupations project of the Occupational Research Section of the Research Branch which is using PERT techniques in an attempt to complete this very complex project on schedule.

(4) Contracting Out Projects in Support of Intramural Programs

71. In all the research areas of the department described earlier in this paper the use of contracts to support the intramural research programs is fairly common. In particular, the Pilot Projects Branch made extensive use of educational consultants in developing new techniques of training. Most electronic data processing support for research projects in the department is contracted out as well as other sub-projects which require highly specialised skills for a short period of time.

(5) Policies Regarding the Funding of Extramural Research Programs.

72. In general, the departmental policy in funding extramural research programs, aside from those dealt with under Section 7 b) on units exclusively concerned with extramural research activities, are

that the research contracted for, whether this is in the universities or industry, is seen as an integral part of the intramural research programs of the department. That is to say, funds expended by units which are primarily concerned with intramural research are used solely to further that research, not to support other programs which are not directly related.

(6) Shifting Resources

73. The process by which the decision is made to shifting resources from one research program to another is part of that process described earlier as the program planning and program review process. That is to say, in the regular review and evaluation of research in the department, if it is discovered that a research program is no longer needed as urgently as another and there is a need to shift resources, this is done as a part of the priority setting and implementation procedure. In general, the department maintains sufficient flexibility in its research plans to take account of unexpected needs in the course of a fiscal year without having to carry out any drastic shifting of resources. Over longer periods of time the planning procedure permits sufficient foreknowledge of such shifting to avoid any real difficulties.

(7) Transfer of Research Results

74. The distribution of research results outside the department is handled in a variety of ways. Material which it is felt is of urgent interest to other federal agencies, or provincial departments, is made available for their restricted use directly upon it being available to this department. Other research results which the department feels would be of interest to the general public are presented in the form of a research monograph which is published by the Queen's Printer and available from them. The department also maintains a mailing list of those persons who are most likely to be concerned with the research results in our area and these people receive such publications as soon as they are available.

b) Units Exclusively Concerned with Extramural Activities

75. The Department has three programs to support extramural research activities. These are the Manpower and Immigration Research Grant Program, the Vocational Rehabilitation Research Grant Program, and the Federal-Provincial Manpower Training Research Program. The set of questions will be answered individually for each program.

MANPOWER AND IMMIGRATION RESEARCH GRANT PROGRAM

(1) Describe Process Whereby Various Types of Programs and Projects Are Accepted For Funding and Relationship Various Factors have on the Acceptance Process.

76. Projects submitted under the Manpower and Immigration Research Grant Program are given a preliminary screening by a departmental committee to determine their relevance to departmental research needs. Those which are determined to be sufficiently relevant are then appraised by consultants both within and outside the Department for technical soundness. Any comments or suggestions for changes made by the consultants with which the Department agrees are forwarded to the researcher for possible inclusion in his final research project proposal.

(i) Previous record of achievement of unit or individual requesting funds

The previous record of achievement of the researcher requesting funds is taken into account where the Department is familiar with the individual's work. When the Department is not familiar with the researcher, references are requested from persons competent to judge, on the basis of past performance, his ability to carry out the project proposed.

(ii) Nature of proposed project

If a project does not fall within the priority areas of research needed by the Department it has little chance of success. A few projects may be accepted each year which are less directly related to priority areas, but very definitely within the terms of reference or of

interest to the department. In general, the department provides support for projects with fairly direct applicability to operations or policy formation, although basic research is not excluded.

(iii) Policies of granting agency

The policies of the department are fairly flexible as regards this program except on the matter of the need of the project to fall within a priority area; for example, there is no policy which states that an individual must be at a university to receive a research grant although, in general, only researchers who have at least completed their comprehensive examination for their Ph.D receive support.

(2) Establishment of Priorities

77. The priorities are established by consultation among the senior managers of the department and ratified by the Deputy Minister. These are updated on a regular basis. As projects are received they are given priority ratings in accordance with these pre-established departmental research priorities.

(3) Monitoring of Projects and Evaluation of Results

78. Most projects are monitored through semi-annual or annual progress reports which are examined by researchers in the department and comments and suggestions passed to the researcher undertaking the project. The final report is similarly evaluated and the results examined for possible operational or policy implications. Both the results of research and the evaluations and implications of these results are passed to the appropriate managers throughout the department.

(4) Priority Implementation and Allocation of Resources to Programs and Projects

79. See paragraph 77.

(5) Network Methods

80. Network methods such as CPN or PERT are not used to plan and monitor grant programs or projects.

(6) Shifting Resources

81. The department has not found occasion to shift resources from one research project to be carried out under grant to another. However, changing circumstances could require that a grant not be renewed. Since it is made clear that the renewal of a grant is not automatic, but is conditional upon the priority of the research and the value and validity of the results, the department has not encountered any difficulties in shifting resources from one priority area to another.

(7) Transfer of Research Results

82. See paragraph 78 above. Also provision is made for the researcher to publish the results of his study.

(8) Percentage of Funds Available Actually Expended

83. This program did not begin operating until the fiscal year 1967-68 therefore there is nothing to report.

(9) Percentage of Funds Requested Actually Granted

84. The same comment applies here as in paragraph 83.

VOCATIONAL REHABILITATION RESEARCH GRANT PROGRAM

85. All the comments made under the Manpower and Immigration Research Grant Program apply equally to this program.

MANPOWER TRAINING RESEARCH PROGRAM

86. This program is one of shared cost research with the provincial governments under agreements provided for by the Adult Occupational Training Act.

(1) Describe Process Whereby Various Types of Programs and Projects are Accepted For Funding and Relationship Various Factors have on the Acceptance Process.

87. Under the terms of the agreement under which the program

operates in each province, research proposals are submitted to the federal government by the provincial government. In many provinces these projects come from outside the provincial department and are therefore subject to screening and approval by a provincial committee before being forwarded to the Department of Manpower and Immigration. The approval procedure in the Department of Manpower and Immigration is similar to that used for the other two grant programs; that is, the project proposal is subjected to an intensive technical appraisal before it is approved.

(i) Previous record of achievement of unit or individual requesting funds

The previous record of achievement is again taken into account or if the record is not known references are requested.

(ii) Nature of proposed project

A project, to be approved under this program, must fall within the terms of reference outlined in the agreement under which the program operates.

(iii) Policies of granting agency

The comments would be the same as for the previous programs.

(2) Establishment of Priorities

88. Priorities are established between projects on the basis of consultation with the provinces concerning the areas where research is most needed in relation to manpower training.

(3) Monitoring of Projects and Evaluation of Results

89. The comments here are the same as for the previous programs.

(4) Priority Implementation and Allocation of Resources to Programs and Projects

90. See paragraph 88 above.

(5) Network Methods

91. Network methods are not used at the present time to plan or monitor grant projects.

(6) Shifting Resources

92. The shifting of research resources from one project to another in this program would be based on the same considerations as with the other two programs. Major shifts between types of projects in terms of priorities or shifts of financial resources away from the present major areas of concern would likely be based on consultations with the provincial departments concerned. As the situation has not yet arisen there are no current difficulties to report.

(7) Transfer of Research Results

93. See paragraph 89 above.

(8) Percentage of Funds Available Actually Expended

94. The Department of Manpower and Immigration became responsible for this program in fiscal year 1966-67. In that year there was no firm budget for shared-cost research; i.e., funds for shared-cost research were drawn from the total budget for shared-cost training, as needed.

(9) Percentage of Funds Requested Actually Granted

95. In fiscal year 1966-67, the department approved projects representing 83 per cent of the total funds requested. Claims against these approvals in that year, however, totalled less than 10 per cent of the total approved since most of the research projects were of a long-term nature, spread over several fiscal years, with the major expenditures being made in later phases.

8. Research Outputa) Patents arising from research activities

96. No patents have arisen from the research activities of this Department.

b) Books or journal articles arising from research activities.

97. For a list of these, see Appendix A.

98. Since the Department of Manpower and Immigration came into existence only in 1966, many of its research activities have not yet reached the stage at which results can be published. As an example, one might mention the project to produce a Canadian Classification and Dictionary of Occupations, which will be an important reference work when it is completed. Work has also been undertaken on method of projecting manpower requirements and supplies, in the long run, and a longitudinal study of immigrant adjustment has been started. These works will not be completed for several years.

c) Reports issued from agency and units

99. Reports prepared in this Department are of two kinds: periodical reports issued at regular intervals, and special reports dealing with particular topics. In addition, every extramural research project financed by the Department, through a grant or a contract, must produce a report. These, however, are not always published by the Department; in many cases, the author may publish the report as an article in a learned journal, or otherwise.

100. For a list of reports, see Appendix B.

d) Conferences or other means used to transfer information regarding the results of a project or programme to extramural groups.

101. Many members of the staff of the Program Development Service sometimes attend conferences of learned societies, such as the Canadian Economic Association, the American Economic Association, or the Canadian Council for Research on Education. At such conferences ideas and information about research in progress or completed are exchanged. However, a conference is rarely the principal medium for publishing the results of a specific piece of research done in the Department. Extramural

research projects financed by the Department are perhaps more often the subject of papers read by the authors at meetings of learned societies.

102. Discussions relating to research done, in progress, or being planned, are often held at specialised conferences organised by government and private agencies interested in a particular field of work. Examples of such conferences recently attended by representatives of the Department of Manpower and Immigration are:

- (i) Sixth Federal-Provincial Conference on Labour Statistics, Esterel, Quebec, 9th May, 1967, at which the Director of the Manpower Information and Analysis Branch gave a paper on "Operational Uses of Job Vacancy Information."
- (ii) Joint Meeting on Corporative Aid to Higher Education, attended by representatives of the Association of Universities and Colleges of Canada, and of other organisations interested in higher education, including this Department, at Montebello, Quebec, 5th February, 1968 at which the Director of the Manpower Information and Analysis Branch gave a talk on the forecasting of requirements for professional manpower.
- (iii) Seminar on Indian Family Relocation Projects, attended by representatives of the Department of Indian Affairs and Northern Development and of the Department of Manpower and Immigration, at Ottawa, 10th to 12th September, 1968 for the exchange of information. The Program Development Service carries on or finances research to evaluate the results of the relocation projects, with a view to planning future relocation projects.

103. Planned for the coming year is a North American Seminar on cost-benefit analysis applied to manpower programs, sponsored jointly by the Canadian Department of Manpower and Immigration and the United States Department of Labour.

- e) The means for the transfer of scientific and technological data obtained from countries outside Canada, to extramural groups

104. Publications of the OECD on manpower matters are distributed by the Department of Manpower and Immigration.

- f) Individuals who had the opportunity to train themselves in specialised fields whilst employed with you and subsequently left and made important contributions to their field.

105. The Occupational Research Section of the Research Branch gives training to its staff in types of work (chiefly occupational analysis, definition and classification) in which training is not readily obtained elsewhere. Persons employed for the summer, such as students or guidance personnel from schools, find this training valuable in their subsequent work. Other staff members who leave the Section are often able to use their training in other positions - for example, in personnel work in industry, in educational institutions, or in other federal or provincial government departments.

106. While Occupational Research appears to afford the most striking example of this phenomenon, because of the special character of the work, the same type of benefit no doubt will accrue to a greater or less extent to persons employed in research in other fields in the Department.

- g) Research teams that have arisen in this period and who have unique and valued abilities in important fields.

107. Work on the Canadian Classification and Dictionary of Occupations has developed a research staff with unique experience in occupational analysis and classification.

108. Similarly, the team of regional economists and analysts being developed in the Manpower Information and Analysis Branch is unique and is filling a previously unsatisfied data collection and analysis need.

109. The longitudinal study of immigrants, which involves following the experience of a sample group of immigrants through several years, while they are adjusting to life in Canada, will be launched on 1st January, 1969 by the Immigration and Foreign Manpower section of the Research Branch. A research team has been developed, including one economist and one sociologist, who have already acquired valuable skill in the course of

developing the methodology for the study.

110. A highly qualified team of economists and statisticians is developing in the benefit/cost area of the Planning and Evaluation Branch's work. Also, the work of the Manpower Requirements Section of the Research Branch in long and middle range projections is producing a significant team of researchers developing new methods and acquiring scarce skills in this area.

h) Unique or valuable research tools, facilities, or processes added or developed during the above period.

111. The most important research tools which have been developed in the Department include the following:

- (i) Benefit/cost analysis, which is still in an early stage of development, is being applied by the Planning and Evaluation Branch in the evaluation of Departmental programs. This represents one of the first attempts to apply benefit/cost analysis to manpower programs, and therefore a great deal of conceptual ground is being broken. The results of this Branch's analytic work will have impact for other agencies and for the governments of other countries.
- (ii) The methodology of the Job Vacancy Survey which was recently established, and which is being administered by the Dominion Bureau of Statistics, was worked out in consultation between the Bureau and this Department. Such a survey has not yet been established in any other country.
- (iii) An econometric model for calculating projections of manpower requirements is being designed in the Manpower Requirements Section of the Research Branch.
- (iv) A periodical survey of highly qualified manpower (for obtaining current statistics on the requirements for, and supplies of, such manpower, the prevailing rates

of remuneration, etc.) was designed in the Manpower Requirements Section of the Research Branch, and is being administered by the Manpower Information and Analysis Branch.

- (v) Methods for analysing, describing, defining and classifying occupations have been developed in the Occupational Research Section of the Research Branch. These methods have been developed chiefly for the work on the Canadian Classification and Dictionary of Occupations, which will also itself be a valuable research tool when it is finished.
- (vi) Research on immigrants, especially in preparation for the longitudinal study referred to above (in subsection g)), has required the development by the Immigration and Foreign Manpower Section of such research tools as questionnaires for immigrants, methods for tracing non-respondents to surveys, ways of maintaining contact with respondents. No methods previously existing were exactly suitable to this problem.
- (vii) The techniques of collecting, analysing and estimating current and short-term future labour requirements and supplies on a detailed occupational and geographical basis are being developed and applied by the Manpower Information and Analysis Branch.

- i) Details concerning the impact of your scientific activities and research output on the advancement of scientific knowledge and Canadian economic development.

112. Since research in this Department is directed toward serving the needs of the Department's operational programs, the chief impact of the research is through its effects on those programs, including such programs as the occupational training of adults, the selection and admission of

immigrants, the relocation of workers, etc. The operational programs of other government agencies will also be affected in some cases. Thus, in many ways, the research activities of this Department should aid Canadian economic growth and productivity.

113. At the same time, the scientific activities of other organisations both governmental and private, will be benefited by the research tools which are being developed (which have been mentioned in the immediately preceding subsection). As an outstanding example, the Canadian Classification and Dictionary of Occupations which is being developed, will be of use to the Dominion Bureau of Statistics, to several other agencies of the Federal Government and to many other organisations. The studies being made of the demands for and supplies of highly-qualified personnel, both currently and in the future, will be of obvious use to, among others, educational institutions.

114. The research units of the Department of Manpower and Immigration are also the primary source, within Canada, of certain categories of information which are important to the Canadian economy and the Canadian population in general. Examples are: current data on manpower demand and supply, especially in regional and local markets; and current data on immigration into Canada.

j) Any other measures or indications of research output

115. No comment.

9. Projectsa) List of titles of projects

116. Since the Department has only existed since October 1966, there are not a great many projects to report. Those which were begun in 1966 or 1967 are listed in Appendix C.

b) Case histories of most significant projects

117. Very little research which was started since this Department was formed has been finished at this point. However, below are reports on five which have been either completed, or are well under way, and which are quite important.

(1) Development of Job Vacancy Survey

118. Data on the demand for manpower have, for a long time, been deficient in comparison with the abundant data on manpower supplies. When the Department of Manpower and Immigration was established and given the responsibility for improving the utilization of Canada's manpower resources, it was felt that a Job Vacancy Survey must be established as soon as possible, in order to fill this serious gap in our knowledge of labour market conditions. Studies and research concerning job vacancy data in Canada, the United States and other countries clearly indicated their operational usefulness in several major areas: job placement and counselling activities of the Canada Manpower Centres; training, mobility and immigration planning at regional and national levels; and manpower planning in industry. The results would certainly identify labour shortages in certain occupations, industries and areas and, in conjunction with data on the skills of available workers, would help in determining needs for remedial action through mobility and retraining programs and through adjustment in immigration flows.

119. Consequently, one of the first steps of this Department was to embark on the development of a systematic collection of comprehensive job vacancy data, in co-operation with the Bureau of Statistics. These efforts have now reached the stage when the first results of what will be a nation-wide survey extending to all sectors of the economy will be available for testing, evaluation and use by the Department by the middle of 1969.
120. The purpose of the Job Vacancy Survey is to obtain periodic estimates of the size, occupational, geographical and other characteristics of the unsatisfied demand for labour. It is a sample survey carried out by means of questionnaires mailed to hiring authorities, and followed up by personal interviews. It is a comprehensive survey, in the sense that it covers firms and organizations of all sizes and in virtually all fields of economic activity.
121. While the survey is being carried out for the Department by the Dominion Bureau of Statistics under contract, its planning and development was a co-operative effort by both agencies. The first stage, in the summer of 1966, involved a pilot survey of employers in a few representative communities, by means of a mailed questionnaire. This resulted in the redesigning of the questionnaire, the sharpening of the concept of a "job vacancy", and the undertaking, as the second stage of the development, of a comprehensive program of interviews of the larger employers to locate the appropriate job vacancy reporting units within these larger firms.
122. The third stage of development was entered in September 1968 with the launching by the Dominion Bureau of Statistics of a mail and interview survey to gather the desired job vacancy data.
123. It is expected that the Job Vacancy Survey will reach its full planned coverage of employers in 1970, and will then embrace about one-half million reporting units, and will extend to all sectors of the Canadian economy except agriculture.

(2) Development of the Occupational Training for Adults Program

124. One of the most important development projects during the first year of the Department's existence was the planning of a new program of Occupational Training for Adults, to replace the Technical and Vocational Training Program previously carried out under the Department of Labour through agreements with the provincial governments.

125. The object of the new program was to assist in the attainment of the Department's goals of better utilization of Canada's manpower resources and the improvement of their quality.

126. To discover how occupational training in Canada might be improved, several of the principal officials of the newly-established Program Development Service, during 1966, made intensive surveys of the operation of existing Technical and Vocational Training Programs and studies of the international literature on the subject. Special surveys were made through questionnaires circulated among representative samples of trainees and of unemployed persons.

127. The study influenced the character of the Adult Occupational Training Act (1966-67, Chapter 94) which came into force on May 8, 1967. This Act empowered the Department of Manpower and Immigration to establish a new system of Occupational Training for Adults, which would be implemented through agreements to purchase training with provincial governments. Under the new program, the Federal Government ceased to extend financial support to vocational secondary schools, which form part of the normal system of secondary education of the province. The new program was intended entirely to assist the occupational training of adults, with a view to their employment.

(3) Professional, Scientific and Technical Manpower Survey 1967

128. In order to obtain current data on Canada's highly qualified manpower, the Research Branch and the Manpower Information and Analysis Branch jointly conducted a Survey of Professional, Scientific and Technical Manpower in 1967. The survey included persons employed in the fields of architecture, engineering, physical science, life science and social science. The data were gathered by means of a questionnaire which was designed with the co-operation and assistance of representatives from scientific and professional associations, educational institutions and government departments. It was mailed to 91,000 individuals whose names and addresses were obtained from the Scientific and Technical Personnel Register previously maintained by the Department of Labour, and a variety of other sources including directories of professional associations, educational institutions and government departments. The original mailing list included about 87,000 Canadian residents, equal to about 31 per cent of the number of holders of university degrees reported in the 1961 Census of the Canadian labour force.
129. The survey was conducted during the first three months of 1967. A response rate of 74 per cent was obtained, and a follow-up of a sample of the non-respondents was conducted by the staff of the Canada Manpower Centres. This procedure provided the basis for making estimates for the total survey population. The survey data are thus of the nature of estimates; they include data reported by the respondents together with estimates of the initial non-respondents based on data obtained in the follow-up.
130. The information collected in the survey related to a large number of factors, including those of employment field, level of education, age, sex, industry group, work function, birth place, and annual earning rates. The four tables of data attached as an appendix indicate the type of information collected.

Table 1

Estimates of Highly Qualified Manpower
residing in Canada by region of residence,
and labour force status

Region	Employed		Student Number	Other ⁽¹⁾	Total ⁽²⁾
	Employee	Self-Employed			
Atlantic	3,779	246	227	149	4,401
Quebec	14,895	1,850	710	552	18,007
Ontario	29,451	2,709	1,814	927	34,901
Prairie	9,764	1,351	623	269	12,007
British Columbia	6,218	806	487	361	7,872
Yukon & N.W.T.	114	-(3)	-	-	125
Total ⁽⁴⁾	64,227	6,968	3,865	2,265	77,325 ⁽⁵⁾

(1) Includes housewives, retired and other.

(2) Includes those who did not state their labour force status.

(3) A dash indicates zero or less than 100.

(4) Includes those who did not state their region of residence.

(5) This total includes 74,465 males and 2,860 females.

Table 2

Estimates of Highly Qualified Manpower employed
and residing in Canada, by field of principal
employment and level of education

Field of Principal Employment	Professional Certification	Bach.-Pass or first Prof. Deg.	Bach.- Honours	Masters	Doctorate	Total ⁽¹⁾
		Number				
Architecture	299	1,530	186	170	-(2)	2,199
Engineering	1,663	23,218	4,603	3,189	643	33,404
Phys. Science	327	3,116	1,635	1,691	2,475	9,267
Life Science	-(2)	4,352	895	1,179	1,249	7,779
Social Science	279	2,567	670	2,133	481	6,157
Other Fields	103	2,742	1,502	1,157	528	6,048
Not Stated	220	2,721	568	570	237	4,363
Total	2,977	40,246	10,059	10,089	5,617	69,222 ⁽³⁾

(1) Includes those who did not state their level of education.

(2) Less than 100.

(3) Includes those who gave no information on level of education or field of employment.

Table 3

Estimates of H.Q.M. employed and residing
in Canada by field of principal
employment and region of employment

Field of Principal Employment	Region					Total (1)
	Atlantic	Quebec	Ontario	Prairie	British Columbia	
Architecture	-(2)	561	983	297	281	2,199
Engineering	1,866	8,631	15,021	4,594	3,204	33,401
Phys. Science	463	2,011	4,429	1,576	670	9,167
Life Science	548	1,558	2,690	1,845	1,124	7,777
Social Science	307	1,125	3,083	1,010	621	6,156
Other Fields	397	1,068	3,207	737	632	6,047
Not Stated	289	1,091	1,932	756	394	4,465
Total	6,926	16,045	31,345	10,815	6,926	69,212

(1) Includes Yukon and N.W.T.

(2) Less than 100.

Note: The total of 69,212 reported in this table is slightly less than the total reported in Table 2 (69,222) due to the estimating procedure.

Table 4

Estimates of H.Q.M. employed and residing
in Canada, Mean Annual Rate of Earnings in 1967,
by field of principal employment and employment status

Field of Principal Employment	Employee		Self-Employed	
	No. Reporting	Mean Earnings \$	No. Reporting	Mean Earnings \$
Architecture	863	10,859	-(1)	-
Engineering	28,908	12,148	2,285	17,249
Phys. Science	8,248	11,991	655	15,573
Life Science	6,306	10,714	515	12,918
Social Science	5,315	12,132	367	18,672
Other Fields	5,483	10,454	387	14,911
Not Stated	2,834	11,665	282	17,412
Total	57,957	11,765	4,537	16,411

(1) Less than 100.

(4) Projection of Canada's Manpower Requirements to 1970

131. This project was originally undertaken in the Department of Labour shortly before the formation of the Department of Manpower and Immigration, in an effort to estimate some of the possible manpower implications of the projections of Canada's potential output to 1970, prepared by the Economic Council of Canada for its First Annual Review, published near the end of 1964. Another obvious purpose of the projections of manpower requirements was to assist the planning of manpower policies and programs by the Department responsible.

132. These projections were prepared through a co-operative effort by Professor Noah M. Meltz of Scarborough College, Toronto, working on contract and economists who were at first members of the Department of Labour, and later members of the Department of Manpower and Immigration. The work began in 1965 and a report was printed in 1968.

133. The data used in the study included the projections of potential output prepared by the Economic Council and labour force data from the Dominion Bureau of Statistics, including data both from the Census and from the Labour Force Survey. From this material projections were computed of

- (i) the industry structure of manpower requirements in 1970;
- (ii) the occupation structure of manpower requirements in 1970;
- (iii) the required education structure of the labour force in 1970; and
- (iv) the required education structure of entrants to the labour force between 1961 and 1970.

134. Such a projection must be a mathematical exercise based on a number of assumptions, and it is realistic only to the extent that the assumptions are realistic. These projections of manpower requirements, nevertheless, show approximately what the principal trends will be under the conditions assumed, and are consequently useful. Moreover, this has been a pioneer study, for which suitable new techniques were developed, and experience gained which will be useful in the future.

(5) A Canadian Classification and Dictionary of Occupations

135. The very rapid development of the Canadian economy in the last two decades and the numerous occupational changes have accentuated a long-felt need for a single, multipurpose classification of occupations, based on a country-wide program of job analysis.

136. Although each economy makes similar responses to technological change its occupational structure is modified largely in accordance with its own policies, developments and goals. It is essential to establish a system suited to national requirements. As a result, the concept of a standardized occupational code has come to be recognized as being essential for effective manpower planning, manpower operations, and career development.

137. Because no standard classification of occupations had been developed in Canada, the country in the past resorted to the use of a number of different systems. The Dominion Bureau of Statistics developed its classification, specifically for Census purposes, but the classes lacked definitions. The National Employment Service, in the absence of a code suited to its needs, adopted the United States Dictionary of Occupational Titles, and the Immigration Branch made use of the International Standard Classification of Occupations.

138. The data compiled in one system could not be compared satisfactorily, for analytical purposes, with data compiled in the other two systems, nor could the data be used for planning or the integration of operational activities.

139. The U.S. Dictionary includes occupations not found in Canada and lacks some that are; it does not meet the requirements of the Dominion Bureau of Statistics for Census purposes; it is not multi-purpose in concept; it is specialized to a greater degree than is useful in Canada; and it is not available in the French language. Some of the D.O.T. definitions, prepared a number of years ago in the United States, are no longer valid in Canada today.

140. While the use of several classifications was a handicap at a time when the rate of change in the occupational structure was comparatively slow, the current pace accentuates the need for a standard classification, providing for uniformity of data on occupations as performed in Canada.

141. Therefore, the Department of Manpower and Immigration and the Dominion Bureau of Statistics are now jointly engaged in the development of the Canadian Classification and Dictionary of Occupations (CCDO).

142. The main purpose of the CCDO will be to provide for Canada a multipurpose instrument for use in manpower research, the formulation of policies and support of programs, for statistical survey purposes, census taking, and for operational activities such as rehabilitation of the handicapped, selective immigration, and mobility of workers within the country. It will facilitate analysis of manpower economics, job market forces, and employment conditions; it will enable better counselling and placement services; it will provide essential data for the planning of educational and training programs; it will have many uses for personnel and manpower operations in business and industry.

143. The Canadian Classification and Dictionary will be based on the principle of "work performed", but to ensure clarity, account will be taken of supplementary factors such as materials, products, services, education and training, physical demands, tools, equipment, and working environment.

144. Group categories as well as the individual occupations will be defined in accordance with data based on job and occupational analysis and/or verification, validation and consultation with experts in each field. All occupations will be classified according to the nature of their work regardless of the kind of establishment in which they are found.

145. There is an emphasis in the Classification on the transferability of skills from industry to industry and product to product - an approach that is useful in a time of rapid occupational change.

146. For statistical purposes the Classification will have three levels with a total of about five hundred groups of occupations, but for operational purposes it will have specific occupational titles that will run into many thousands.

147. Each group of occupations will be homogeneous in nature, and within each unit or class the occupations will be grouped according to kinds of work performed and skills and abilities required; they will be arranged generally in descending order of complexity. This will permit the designation of a number of levels and kinds of skills. It will give not only the entry occupations but also the advancement possibilities to occupations that require greater degrees of skill and knowledge.

148. The problem of the social scientist is to find a classification that will enable him to ascertain the actual changes which have taken place in the structure of the labour force, so as to carry out analytical studies and to make projections and forecasts. It is highly desirable, therefore, in designing a new classification to ensure, as much as possible, the historical continuity of statistical data. Therefore, so far as is both practicable and advantageous, the CCDO will be convertible to the Canada Census 1961 so as to provide for historical continuity, and it will be related to the revised International Standard Classification of Occupations for purposes of international studies and reports; it will also be convertible to the U.S.E.S. Dictionary of Occupational Titles because of its usage in the past thirty years.

149. A standard multipurpose occupational classification should be designed to meet the various needs of statisticians, census takers, analysts and counsellors - who usually work with the broader groupings - as well as the needs of placement officers, employers, training officials and manpower planners - who require the more precise and specific occupational titles.

150. The vast amount of data obtained through occupational analysis will be recorded on magnetic tape. This will be used to facilitate the publication of the several volumes that are planned; and it will be made available for a wide variety of uses in research and analysis. If a computerized occupational information service is provided to subscribers across the country the data on this magnetic tape could provide a substantial input.

151. The CCDO is to be published in both English and French.

152. It is anticipated that when the whole of the present project is completed there will be a program of continuous revision to take into account subsequent or impending changes in the occupational structure.

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APPENDIX A

List of Books and Journal Articles Arising
from Research Activities, 1966-1968

Table A(1): Regular Publications by
the Department

Table A(2): Special Publications by
the Department

Table A(3): Journal Articles

Table A(1): Regular Publications
by the Department

Occupational Research

The Occupational Research Section of the Research Branch undertakes research to produce and revise four different publications:

Canadian Occupations - Briefs: Short outlines of factors affecting the choice of a career, such as the nature of work, personal qualities, and occupational outlook. They are used extensively in vocational counselling.

Canadian Occupations - Entry Requirements: Legalistic and regulatory data to acquaint prospective immigrants with Canadian employment conditions in a particular occupation.

Bibliography of Career Information Publications

Canadian Occupations Monographs: Considerably longer than Briefs, and indicate to the reader the relationships between various related occupations in a group.

Manpower Information and Analysis

University, College, and Technological Institute Guide: A statistical summary published annually in June. Contains tables on estimated starting salaries for university and technological institute graduates and on estimated graduations and enrolments by discipline and by university (graduate and undergraduate) or technical institute.

Canadian Institutes of Technology and Related Industries: Full-time post-secondary enrolment. A survey conducted annually on a co-operative basis with the Education Division of the Dominion Bureau of Statistics.

Operational Retrieval Newsletters: A series of specialized newsletters designed to relay labour market information to Canadian university students studying abroad.

Directories of Canadian Recruiting Employers: Published in connection with Operation Retrieval: contains profiles on 700 employers recruiting Canadian university students studying abroad.

Directory of Canadians Studying in the United Kingdom: Printed in 1966 and 1967, replaced in 1968 by "List of Canadians Studying Abroad".

Directory of Canadians Studying in the United States: Printed in 1966 and 1967, replaced in 1968 by "List of Canadians Studying Abroad".

List of Canadians Studying Abroad and Available for Employment in Canada: To inform Canadian employers of highly trained and professional talent that will be available for employment later in the year.

Career Outlook for University Graduates: Published annually, contains information on career opportunities available to students in various disciplines, expected starting salaries, course offerings and other developments in university education.

Career Outlook for Technological Institute Graduates: Published annually, contains information on career opportunities available to students in various disciplines, at institutes of technology and community colleges, expected starting salaries, course offerings and other developments.

Anticipated Requirements and Rates of Pay for University Graduates: Published annually: up-to-date estimates of anticipated starting salaries for university graduates from various fields of study.

Table A(1) (Continued)

Anticipated Requirements and Rates of Pay for Technological Institute Graduates: Published annually: up-to-date estimates of anticipated starting salaries for technological institute graduates from various fields of study.

Mid-Season Survey of Anticipated Requirements and Rates of Pay for University Graduates: Published annually in February, a supplement to the Fall survey.

Mid-Season Survey of Anticipated Requirements and Rates of Pay for Technological Institute Graduates: Published annually in March, a supplement to the Fall survey.

New University Graduates: Supply and Demand: An analysis of the supply and demand situation for new university graduates - deals principally with past and present supply of graduates by faculty, the demand for graduates and the starting salary rates paid to each discipline, published annually.

Rehabilitation Research

Rehabilitation in Canada: Periodical dealing with developments in Canada and the world in the field of rehabilitation of the handicapped and the older worker, two issues per annum.

Table A(2): Special Publications
by the Department

Gross Movements of the Labour Force, by Mary Hutton and A.N. Polianski, published 1966.

National Needs in Educational Planning in Emerging Strategies and Structures for Educational Change, by K.V. Pankhurst, published by Ontario Institute for Studies in Education, 1966.

A Selected and Annotated Bibliography for Policy and Research: Labour Mobility, published 1967.

A Selected Bibliography for Policy and Research: Cost/Benefit Analysis, published 1967.

A Selected Bibliography for Policy and Research: Manpower and Education, published 1967.

Career Decisions of Canadian Youth, a Compilation of Basic Data, Volume 1, study conducted by R. Breton and J.C. McDonald, published 1967.

Manpower Implications of Prospective Technological Changes in the Eastern Canadian Pulpwood Logging Industry, by D.R. Campbell, E.B. Power and published 1966.

The Geographic Mobility of the 1955 Class of Graduates from Canadian Universities in Science and Engineering, by D. Dyck, published 1967.

Manpower in Canada, 1931-1961, by N.M. Meltz, published 1968.

Canada's Manpower Requirements to 1970, by N.M. Meltz and G.P. Penz, published 1968.

The Counsellor and Canada's Manpower Markets, by K.V. Pankhurst, published 1968.

Study of Labour Market Information Systems: Final Report, by N.M. Meltz, published 1968.

Table A(3): Journal Articles

Migration Between Canada and the United States, by K.V. Pankhurst, Annals of the American Academy of Political and Social Sciences, Philadelphia, Volume 367, September 1966.

Manpower Requirements in the Construction Industry, by F.D. Upex, Journal of the Canadian Construction Association, 1967.

Manpower Mobility Program - A Pilot Project in the Method of Evaluation of Government Programs, by A.N. Polianski. Paper delivered at 25th interstate conference on Labour Statistics, June 1967.

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APPENDIX B

List of Reports Issued from Department of
Manpower and Immigration 1966-1968

Table B(1): Periodic Reports

Table B(2): Special Reports

Table B(3): Reports Resulting from
Research Grants

Table B(1): Periodic Reports

National Manpower Review	Bi-monthly
Regional Manpower Review	Bi-monthly
Canada Manpower Bulletin	Monthly
The Labour Force: Employment and Unemployment (jointly with Dominion Bureau of Statistics)	Monthly

Table B(2): Special Reports

	<u>Year of Publication</u>
Production Functions for Canadian Manufacturing Industries, 1947-1961, by Y. Kotowitz	1966
A Method for Determining the Nature of a Skill Bottleneck: A Pilot Study, by D.A. Dodge	1966
Manpower Mobility Program: Six Months' Statistical Report, December 1965-June 1966	1966
Three Reports on French Immigration to Canada:	1967
(1) Image of Canada in France, by Institut Français d'Opinion Publique	
(2) Attitude of French-Canadians regarding Immigration, by Institut Français d'Opinion Publique	
(3) French Immigrants in Greater Montreal, by Prof. J. Brazeau, Université de Montréal	
Operation Retrieval: Evaluation	1967
Economic and Employment Outlook for 1968	1967
Characteristics of Unplaced Applicants and Trainees in Program 5:	
Volume I	1967
Volume II	1968
Barriers to Mobility, by Prof. Jane A. Abramson, University of Saskatchewan	1968
Efficiency in the Allocation and Utilization of Manpower, by M. Galatin	1968
Utilization of Caribbean Seasonal Labour	1968
Problems and Prospects of Increased Japanese Emigration to Canada: A Case Study of the Attitudes of a Selected Sample of Japanese Canadians to Immigration to Canada	1968

Table B(3): Reports Resulting
from Research Grants

	Year of Receipt of Report
(a) <u>Manpower and Immigration Research Grants</u>	
A Study of the Migrant Population of a Specific Community in Toronto, by W.A. Head, Social Planning Council of Metropolitan Toronto	1968
Immigration to Canada from the British Isles, 1946-64: an Econometric Analysis, by W.R. Needham, University of Waterloo	1968
The Economic Adjustment of North African Jewish Immigrants in Montreal, by Mrs. Naomi Moldofsky, McGill University	1969
The Industrial Structure of Employment in Canada, by R.M. McInnis, Queen's University	1968
(b) <u>Manpower Training Research Grants</u>	
Manpower Training Requirements for Nova Scotia, 1970 and 1975	1966
Manpower Resources and Skill Requirements in the Construction Industry in Nova Scotia	1966
Vocational Plans of Alberta's Youth	1966
British Columbia Manpower: Current Status and Needs of the Future	1966
Present State of Manpower and Future Training Needs in Farming and Farm-Related Industries of the Atlantic Region	1967
An Estimate of Manpower Coefficients, by Industry, in Nova Scotia, with Special Reference to Manufacturing	1967
Survey of Training in Industry and Business (Québec)	1967
Operation Départ (Québec)	1968

DEPARTMENT OF MANPOWER AND IMMIGRATION

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APPENDIX C

List of Projects Conducted 1966-1968

Table C(1): Intramural Research Projects

Table C(2): Extramural Research Projects
Done on Contract

Table C(3): Research Grants by Department
of Manpower and Immigration

Table C(1): Intramural Research Projects

<u>Project</u>	<u>Year Stated</u>	<u>Year Completed</u>
<u>By Planning and Evaluation Branch:</u>		
Development of a new program of occupational training, embodied in the Adult Occupational Training Act, 1967 (described in section 9(b) of the brief)	1966	1967
Review of the Manpower Mobility Program, and drafting of the new regulations which came into effect in 1967	1966	1967
Position paper on the Seasonal Stabilization Program in preparation for 1967 federal-provincial meeting	1966	1967
Evaluation of Operation Retrieval through a survey of Canadian students in the United States	1966	1967
Planning and organization of the annual Program Review of the Department	1967	Continuing
Participation in Immigration Task Force to draft new regulations and procedures for selection of immigrants	1967	1967
Study of qualifications for employment of persons laid off from automobile and parts plants in Oshawa, from information in the files of CMC's	1967	1967
Participation in review of the Vocational Rehabilitation Agreements with the provinces	1967	1967
Position paper on the definition of under-employment	1967	1967
Report comparing the manpower programs of Canada and six other leading industrial countries	1967	1968
Analysis of the emergency functions of the Minister of Manpower and Immigration, as part of an inter-departmental analysis in depth of the total Canada Civil Emergency Measures Program	1968	1968
Construction of a cost/benefit model of CMC referral activity	1968	In progress
Cost/benefit evaluation of the Occupational Training of Adults Program by further adaptation of the cost/benefit model developed by Operations Research Institute	1968	In progress
Cost/benefit analysis of the Manpower Mobility Program	1968	In progress
Paper on the expected tenure of workers in Canadian industries (as part of background for analysis of the Mobility Program)	1968	1968

Table C(1) (Continued)

<u>Project</u>	<u>Year Stated</u>	<u>Year Completed</u>
<u>By Research Branch (Manpower Requirements Section):</u>		
Paper published on "Migration between Canada and the United States"	1966	1966
Projection of manpower requirements in the construction industry	1966	1967
Monograph on Canada's labour markets prepared for use in a training course for manpower counsellors	1967	1968
Preparation for publication of historical statistics on the Canadian labour force, 1931 to 1961	1967	1968
Crash project - projections of supply and demand for manpower, by occupation and region	1968	In progress
Report on supply and requirements, past and future, of engineers and scientists in Canada, based on revision of a doctoral thesis by A.D. Boyd	1968	In progress
<u>By Research Branch (Manpower Supply Section):</u>		
Study of the geographic mobility of the 1955 class of graduates from Canadian universities in science and engineering	1965	1967
Pilot cost/benefit analysis of the (pre-1967) Manpower Mobility Program	1966	1967
Participation in development of a Basic Manpower Data Form for collecting information on rural people receiving ARDA, mobility, or training assistance	1966	1967
Developmental work and evaluation studies on pilot Indian relocation projects	1967	Continuing
Evaluation of seasonal movement to Canada of Caribbean agricultural workers (in co-operation with Planning and Evaluation Branch)	1967	Continuing
Study of gross movements of manpower into and out of the labour force, etc.	1967	In progress
Bibliographies prepared on labour mobility and on cost/benefit analysis	1967	1967
Study of development of data on persons with marginal attachment to the labour force	1967	In progress
Analysis prepared of the vocationally disadvantaged in a technological society	1967	1967

Table C(1) (Continued)

<u>Project</u>	<u>Year Stated</u>	<u>Year Completed</u>
Position paper on information the Department would like from the Supplementary Labour Force Survey	1967	1967
Study of hired labour in agriculture	1968	In progress
Service sector of the economy - study of the feasibility of a comprehensive study	1968	In progress
<u>By Research Branch (Immigration and Foreign Manpower Section):</u>		
Evaluation of the new selection criteria for immigrants (both before and after the criteria were put into use)	1967	In progress
Longitudinal study on immigrants: economic and social integration of a representative cohort of immigrants during their first years in Canada	1967	In progress
Preparation of a set of statistical data on post-war immigration	1967	1967
Study of immigrant family expenditures, based on DBS data and supplementary analysis	1967	In progress
Analysis of the socio-economic adjustment of immigrants, from data on the 1961 applicants for citizenship	1968	In progress
Report on immigration to Quebec, based on review of a study (made on contract) of French immigrants in Greater Montreal, and other extensive material	1968	1968
Pilot study of the recognition given in Canada to trade and professional qualifications obtained in foreign countries	1968	In progress
Study of characteristics of immigrants receiving adjustment support	1968	In progress
Study of Canadians resident in the United States, from U.S. 1960 Census data	1968	In progress
<u>By Research Branch (Occupational Research Section):</u>		
Development of a Canadian Classification and Dictionary of Occupations (described in section 9(b) of the brief)	1966	In progress
<u>By Research Branch (Economic Conditions Section):</u>		
Report on the economic and employment outlook for 1968 (updated by later reports)	1967	1968

Table C(1) (Continued)

<u>Project</u>	<u>Year Stated</u>	<u>Year Completed</u>
<u>By Research Branch (Technology and Productivity Section):</u>		
Study of manpower implications of prospective technological changes in the Eastern Canadian pulpwood logging industry	1965	1967
<u>By Research Branch (General):</u>		
Survey of the characteristics of unplaced applicants registered with the National Employment Service, and of trainees in Program 5 (i.e., training for the unemployed)	1966	1967
Preparation of a statement of the needs of the Department for information from the 1971 Census	1967	1967
<u>By Manpower Information and Analysis Branch:</u>		
Production of area profiles of CMC areas, by branch staff at national and regional headquarters	1967	In progress
Revision and definition of boundaries of CMC areas	1967	1968
Occupational shortages survey, based on information sent in by the CMC's about local manpower shortages by occupation	1967	Continuing monthly
Survey of professional and scientific manpower, Canada, 1967 (described in section 9(b) of the brief)	1967	1968
Survey of graduating classes of Canadian universities, to expand the professional manpower data bank	1968	Annual
Employment forecast survey: quarterly narrative report based on interviews with leading employers	1966	Annual
<u>By Pilot Projects Branch:</u>		
Studies of occupational training for persons in economically stagnant areas through pilot training projects (see the note which follows)	1966	1968

Addendum to Table C(1)Work of the Pilot Projects Branch

The Pilot Projects Branch formed part of the Program Development Service of the Department of Manpower and Immigration from the time of the formation of the Department until late in 1968, when the Pilot Projects Branch was transferred to the Department of Forestry and Rural Development.

The function of this Branch was to develop and administer the Canada NewStart Program. The purpose of this program was to conduct experimental training projects ("pilot projects") to motivate and qualify disadvantaged persons in economically stagnant areas ("pilot project areas") for stable employment.

The pilot projects were organized under agreements between the federal and provincial governments. In each province signing an agreement, a corporation was formed to plan, organize, conduct, and evaluate suitable pilot projects. Each corporation was set up jointly by the federal and provincial governments, but financed by the federal government.

The Pilot Projects Branch maintained a Technical Support Centre to conduct studies in support of the NewStart Program. Extramural consultants were also employed on contract.

Table C(2): Extramural Research Projects Done on Contract

Research By	Year Contract Signed	Year Report Completed	Subject of Study
<u>Contracts Arranged by Planning and Evaluation Branch:</u>			
Operations Research Inc.	1966	1967 ^(a)	Cost/benefit study of program of Occupational Training for Adults
Canadian Centre of Community Studies: Subcontracted to Prof. Abramson, University of Saskatchewan	1966 (c)	1968	Barriers to manpower mobility, in four economically lagging areas in Quebec and Atlantic provinces
Prof. Graeme McKechnie, York University	1967	(b)	Preliminary cost/benefit study of the Vocational Rehabilitation Program
Peat, Marwick and Co.	1968	(b)	Follow-up study of persons assisted under the Manpower Mobility Program: tabulations of results of survey
EDP Associates	1968	(b)	Preparation of a computer program to manipulate data on clients of the Manpower Mobility Program in 1967-68
Prof. C. Pentland,) University of Manitoba;) Prof. Tim Ryan,) Lakehead University;) Prof. J.-M. Tremblay,) University of Montreal)	1968	(b)	Evaluation of manpower adjustment programs arranged by the Manpower Consultative Service at North Sydney, Selkirk, and a Quebec location

Footnotes at end of table.

Table C(2) (Continued)

<u>Research By</u>		<u>Year</u>	<u>Subject of Study</u>
<u>Contracts Arranged by</u>		<u>Contract</u>	
<u>Research Branch:</u>		<u>Signed</u>	<u>Report</u>
			<u>Completed</u>
Prof. Raymond Breton, Johns Hopkins University; Prof. J.C. McDonald, Trent University)	1965	(b)
)	(d)	
)		Career decisions of Canadian youth: a sample survey of the educational and occupational choices of Canadian secondary school students
Prof. Noah Meltz, University of Toronto; with G.P. Penz, Department of Manpower and Immigration		1965	1968
			Canada manpower requirements in 1970, projected by industry, by occupation, and by level of education required
Dr. J.K. Sharma		1966	1968 (a)
			Civilian labour force projection by educational level in Canada, 1970
Prof. Jacques Brazeau, University of Montreal		1966	1968
			Exploratory survey of French immigrants in Greater Montreal
Computing Services Company		1966	1968
			Tabulation of 1964-65 income tax data by province for use in studies of mobility
Prof. David Dodge, Princeton University		1967	1968
			Study of returns to investment in education
Prof. P. Belanger, Carleton University		1967	1968
			Problems and prospects of increased Japanese immigration to Canada: a case study of the attitudes of a selected sample of Japanese-Canadians to immigration to Canada
Prof. S.T. Nielsen, Simon Fraser University		1969	(b)
			A model of the impact of immigration on the economy

Table C(2) (Continued)

<u>Research By</u>	<u>Year Contract Signed</u>	<u>Year Report Completed</u>	<u>Subject of Study</u>
<u>Contracts Arranged by Manpower Information and Analysis Branch:</u>			
Prof. Noah Meltz, University of Toronto	1967	1968	Study of labour market information systems within the Department of Manpower and Immigration
Dominion Bureau of Statistics	1967	(e)	Development and administration of quarterly Job Vacancy Survey
<u>(a)</u> Internal report for use in the Department of Manpower and Immigration.			
(b) Report not yet completed.			
(c) Joint contract shared by the Department, ARDA, and ADA.			
(d) Funds allocated through Manpower Information and Analysis Branch.			
(e) No final report intended: purpose is to develop the Survey.			

Table C(3): Research Grants by Department of Manpower and Immigration, to December 31, 1968

(a) Manpower and Immigration Research Grants			
Researcher and Institution	T.B. Approval Date	Title of Study	Amount \$
W.A. Head Social Planning Council of Metropolitan Toronto	June 1/67	A Study of the Migrant Population of a Specific Community in Toronto	9,924
W.R. Needham University of Waterloo	June 1/67	Immigration to Canada from the British Isles: 1946-64; An Econometric Analysis	2,670
A.G. Green Queen's University	June 1/67	An Economic Study of Canadian Emigration to the United States: 1951-61	4,500
(Mrs.) Naomi Moldofsky McGill University	June 1/67	The Economic Adjustment of North African Jewish Immigrants in Montreal	1,250
(Miss) A.E. Annopoulos McGill University	June 1/67	The Greek Immigrant in Montreal: A Study of Network Analysis	3,000
John A. Sawyer University of Toronto	June 1/67	Research on the Labour Market Within an Econometric Model of the Canadian Economy	11,000
P.E. Coulter Lakehead University	June 1/67	The Evaluation of Equivalent Standing in Canadian Adult Education	2,980
P.M. Rowe University of Waterloo	June 1/67	Decision Process in the Assessment Interview	2,300
R. Marvin McInnis Queen's University	Feb. 2/68	The Industrial Structure of Employment in Canada	9,100

Table C(3) (a) Manpower and Immigration Research Grants (Continued)

<u>Researcher and Institution</u>	<u>T.B. Approval Date</u>	<u>Title of Study</u>	<u>Amount \$</u>
W. Donald Wood Queen's University	March 28/68	Preparation of an Annotated Bibliography on Cost/Benefit Analysis	4,000
Peter Y. Comay Princeton University	April 3/68	The Migration of Professional Manpower Between Canada and the United States	8,300
John A. Sawyer University of Toronto	June 5/68	Research on the Labour Market Within an Econometric Model of the Canadian Economy (Final Phase)	8,750
Gerald Halpern Collegiate Institute Board of Ottawa	Oct. 24/68	Computer-Based Counselling: A Feasibility Study	5,800
John G. Crispo University of Toronto	Oct. 24/68	An Examination of the Allocative Mechanism of the Toronto Labour Market	12,967
Richard Béland University of Sherbrooke	Oct. 24/68	Forecast of Manpower Requirements by Occupational Groups in Canada	4,850

Table C(3) (b) Vocational Rehabilitation Research Grants

Researcher and Institution	T.B. Approval Date	Title of Study	Amount \$
E.J. Signori University of British Columbia	June 1/67	Attitude Toward the Hiring of Socially Disadvantaged Persons	4,100
H.I. Day Ontario Institute for Studies in Education	March 28/68	An Examination of Intrinsic Motivation in Unemployed Male Adults	20,000
W.J. Lockert Canadian Hearing Society of Quebec	May 16/68	The Employment and Utilization of Graduates of Schools for the Deaf in Metropolitan Montreal	27,225
Milton Friedman Jewish Vocational Service of Metropolitan Toronto	June 12/68	Operant Conditioning Techniques Applied to a Rehabilitation Work-Shop to Improve Motivation and Work Habits: A Feas- ibility Study	28,710
David Gibson University of Calgary	June 19/68	Actuarial Forecast of Vocational Habilitation of Mentally Retarded Youth	4,950

Table C(3) (c) Manpower Training Research Grants

<u>Province</u>	<u>Title of Study</u>	<u>Federal Contribution \$</u>	<u>Approval Date</u>
NOVA SCOTIA	Manpower Training Requirements for Nova Scotia, 1970 and 1975	5,326	July 26/65
NOVA SCOTIA	Manpower Resources and Skilled Requirements in the Construction Industry in Nova Scotia	2,635	Nov. 26/65
QUEBEC	The Students' Plans for the Future	2,120	Dec. 22/65
ONTARIO	Effectiveness of Vocational and Technical) Training Programs as Preparation for) Employment in Ontario;) Success in Employment as Related to) School Programs, Guidance Services and) Job Experience in Ontario;) Vocational Guidance in Ontario Schools:) Its Status, Effectiveness and Future)	81,200	Feb. 1/66
ALBERTA	Vocational Plans of Alberta's Youth	3,425	July 26/65
BRITISH COLUMBIA	B.C. Manpower - Current Status and Needs of the Future	4,000	July 26/65

Table C.2
(c) Manpower Training Research Grants (Continued)

<u>Province</u>	<u>Title of Study</u>	<u>Federal Contribution \$</u>	<u>Approval Date</u>
NOVA SCOTIA	Present State of Manpower and Future Training Needs in Farming and Farm Related Industries of the Atlantic Region	16,000	Nov. 9/66
NOVA SCOTIA	An Estimate of Manpower Coefficients, by Industry, in Nova Scotia, with Special Reference to Manufacturing	7,250	Nov. 9/66
NEW BRUNSWICK	An Investigation of Certain Parameters of Manpower Development in New Brunswick	21,750	Mar. 31/67
QUEBEC	Survey of Training in Industry and Business	8,000	Apr. 4/66
QUEBEC	Operation Depart	250,000	Mar. 31/67
ONTARIO	A Study of Factors in Workers' Decision to Forego Retraining	15,000	Sept. 27/66
ONTARIO	The Counselling of Small Groups in South Western Ontario Secondary Schools; The Measurement and Prediction of Success in Vocational and Technical Training Programs using Non-Verbal Material;	288,800	Nov. 25/66

Table C(2) (c) Manpower Training Research Grants (Continued)

<u>Province</u>	<u>Title of Study</u>	<u>Federal Contribution</u> \$	<u>Approval Date</u>
ONTARIO (Continued)	<p>Proposal for a Computer-Based Training Laboratory for the Improvement of Skills Training among Technical, Vocational and other Students;)</p> <p>Proposal to Adopt Computer Technology to the Actual Construction of Time-Tables for Vocational and Composite Schools, Technical Institutes and Colleges of Applied Arts and Technology in Ontario)</p>	Covered by last grant on preceding page	
ONTARIO	Human Resource Planning in Europe; Technology, Education and Employment II Population Study - (Ontario)	60,225	Dec. 20/66
ONTARIO	Technology, Education and Employment I - A Study of Interactions;) A Study of Adult Education Drop-outs)	12,652	Feb. 3/67

Table C(3) (c) Manpower Training Research Grants (Continued)

<u>Province</u>	<u>Title of Study</u>	<u>Federal Contribution \$</u>	<u>Approval Date</u>
NOVA SCOTIA	Management Education Survey and Plan for Nova Scotia	10,750	June 12/68
NOVA SCOTIA	Nova Scotia's Manpower Requirements and Supply 1975 and 1980	5,722	Nov. 8/68
QUEBEC	Operation Sesame	262,500	Dec. 5/68



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THE SENATE OF CANADA

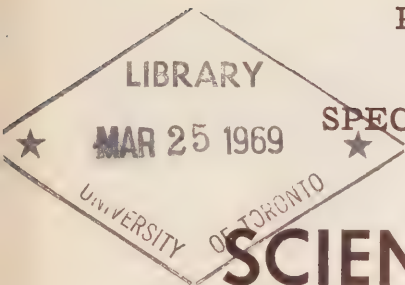
PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY



The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

The Honourable DONALD CAMERON, *Vice-Chairman*

No. 29

WEDNESDAY, FEBRUARY 12th, 1969

WITNESSES:

Public Service Commission: John J. Carson, Chairman; and Dr. Donald H. Laughland, Director, Bio-Physical Sciences Program.

APPENDIX:

30.—Brief submitted by the Public Service Commission.

THE QUEEN'S PRINTER, OTTAWA, 1969

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*
The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird
Belisle
Blois
Bourget
Cameron
Carter
Desruisseaux
Giguère

Grosart
Haig
Hays
Kinnear
Lamontagne
Lang
Leonard
McGrand

Nichol
O'Leary (*Carleton*)
Phillips (*Prince*)
Robichaud
Sullivan
Thompson
Yuzyk

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,
The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,
The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

Wednesday, February 12th, 1969

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 3.30 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Blois, Cameron, Carter, Haig, Kinnear, Robichaud and Thompson—8.

In attendance:

Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

PUBLIC SERVICE COMMISSION:

John J. Carson, Chairman; and

Dr. Donald H. Laughland, Director, Bio-Physical Sciences Program.

In attendance:

Edouard A. Robillard, member of the Bio-Physical Sciences Program.

(*A curriculum vitae of each witness follows these Minutes.*)

The following is printed as Appendix No. 30:

—Brief submitted by the Public Service Commission

At 5.30 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

CARSON, JOHN J., B.A., M.A. Mr. Carson was born in 1919 in Vancouver and studied at the University of British Columbia and the University of Toronto. During World War II he was with the Directorate of Personnel Selection at National Defence Headquarters as a staff captain. After the war, he became senior personnel consultant with J.D. Woods and Gordon, and in 1952, he joined the Ontario Hydro as director of Employee Relations. He joined the B.C. Electric as director of Industrial Relations in 1956 and subsequently became vice-president and assistant to the president. In 1961 he was loaned to the Glassco Commission by the B.C. Electric Co. and in 1964 became a special adviser on personnel to the federal Treasury Board. This relationship with the federal government was culminated when he was appointed chairman of the Civil Service Commission (now the Public Service Commission), September 1, 1965. In 1966, he was appointed a member of the United Nations' International Civil Service Advisory Board. This year he took on the National Presidency of the Canadian Y.M.C.A. Mr. Carson is married and has six children.

LAUGHLAND, DONALD H., B.S.A., M.A., Ph.D., F.C.I.C. Dr. Laughland was born in 1917 in Collingwood, Ontario and is a graduate of the Ontario Agricultural College and the University of Toronto. He served in the Royal Canadian Navy from 1942-1945. He joined the Science Service of the Department of Agriculture in 1945 as a research scientist in the biochemistry and nutrition division. In 1959 he was appointed Director of Administration for the Research Branch of the Department of Agriculture. In 1966 he became Director, Bio-Physical Sciences Program in the Public Service Commission. Fellow, Chemical Institute of Canada; member, Canadian Biochemical Society, Canadian Physiological Society, Nutrition Society of Canada, Agricultural Institute of Canada, Public Personnel Association. Approximately 25 papers in scientific journals in the field of fat-soluble vitamins. Dr. Laughland is married and has four children.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Wednesday, February 12, 1969.

The Special Committee of the Senate on Science Policy met this day at 3.30 p.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: We have the pleasure this afternoon of having with us the Chairman of the Public Service Commission, Mr. John J. Carson, and two of his colleagues, Dr. Donald H. Laughland, Director of the Bio-Physical Sciences Program, and Mr. Edouard A. Robillard who is a member of the Bio-Physical Sciences Program of this commission.

I understand that Mr. Carson does not intend to make any opening statement in support of what is contained in the brief. Therefore, we are now in a position to proceed immediately to the question and discussion period. Senator Haig.

Senator Haig: Thank you, Mr. Chairman. Dealing with the brief presented by the commission, in paragraph 1 you say there should be co-ordination with respect to the recruitment. How is that being done at the present time?

Mr. John J. Carson, Chairman, Public Service Commission: There is no real co-ordination, except of a very informal nature between the exempt agencies and the Public Service Commission. So far as all of the departments and ministries are concerned, the commission does provide very complete co-ordination.

Senator Haig: In respect to positions?

Mr. Carson: No, in respect to recruitment. The co-ordination of whether this department has enough positions or insufficient positions is a Treasury Board responsibility.

Senator Haig: In connection with paragraph 2 you say the inventories and staff techniques should be standardized. How is that being done?

Mr. Carson: There is a pretty complete inventory developing within the departments of Government,

done by the Public Service Commission, both inventories and development of staff appraisal techniques, but there is no consistency between what we are doing for the departments of Government and the independent agencies are doing on their own.

Senator Haig: In other words, there is duplication.

Mr. Carson: There is an exchange of information. Yes, there could be some duplication.

Senator Haig: You mention on page 1 the various changes that have occurred in the act, and you say that these legislative changes have had a more profound impact on personnel management in the Public Service than any other change since the Civil Service Act of 1918. How does this apply?

Mr. Carson: The 1918 act which provided the basis for the merit system in the Public Service of Canada remained virtually untouched until 1967. In 1967 there was a massive realignment of authority and responsibility, the introduction of collective bargaining, the recognition that an independent agency like the commission could delegate out to departments a lot of its historic responsibilities which the previous act prevented us from delegating. It was just a total new philosophy of management flowing, of course, from the Glassco Commission's recommendations.

Senator Haig: In other words, your commission does all the hiring and firing.

Mr. Carson: All the hiring.

Senator Haig: Who does the firing?

Mr. Carson: The departments, sir, are responsible for releasing employees for incompetence and for misbehaviour. In the case of incompetence, the employee can appeal to the commission a decision against release for incompetence. We will hear that appeal and judge whether he really has lost merit or whether he fooled us in the first place and never had merit. In the case of employees being released because of misbehaviour or for disciplinary reasons,

those are handled through grievance procedures and go through the Treasury Board.

Senator Haig: How many members are there in your commission?

Mr. Carson: Engaged in staffing? About 600.

The Chairman: Those are not members of the commission. You have only three members.

Mr. Carson: I misunderstood the question. Yes, we have three members on the commission.

Senator Haig: I thought a 600-member commission was a trifle large.

Mr. Carson: The staff do all the work, senator.

Senator Haig: Mr. Carson, what criterion in your methods do you use in evaluation of a scientist or a personnel man? Do you use personal interviews, university marks, questionnaires, reports from personnel and others in the field?

Mr. Carson: We use all of these things. I will let Dr. Laughland speak specifically respecting the scientists. If you then want me to elaborate on the executive category or administrative personnel, I will.

Senator Haig: Let us deal with scientists first.

Dr. Donald H. Laughland, Director, Biophysical Sciences Program, Public Service Commission: In answer to your question, senator, there are two aspects to this. One is the assessment of scientists coming into the service prior to joining the service and then the assessment or appraisal of them after they are in. I gather you are interested in both aspects. From the standpoint of people entering the service, the assessment is done largely through the personal interview. We conduct very extensive recruiting campaigns, both in Canada and in the United States, and for the past two years we have done so overseas as well. Teams which consist of a commission officer and two or three experts, scientists from departments directly concerned in the area, will visit universities and interview students. I am speaking here chiefly of those in scientific positions at the Ph.D. level. Similar teams also interview students at the Bachelor level.

Assessment is based, therefore, on personal interview, on recommendations from professors, on the academic standing of the student and on any information we can get. On the basis of this a decision is made.

With respect to scientists in the Public Service, their appraisal is conducted in the first instance by

departments. There is a class called the Research Scientist Class which has a special connotation in that only people whose advancement is based primarily on research accomplishment are included. They are appraised annually by departmental committees, and the recommendations of departments come to the Interdepartmental Appraisal Committee consisting of a senior scientist from each of the major scientific departments, a representative of Treasury Board and a representative of the Public Service Commission. The Chairman at the present time of the Interdepartmental Appraisal Committee is Mr. A. M. Pennie of the Defence Research Board.

The Interdepartmental Appraisal Committee then accepts or modifies the departmental recommendation with respect to salaries for scientists. I should also mention that in this class, advancement is strictly on the basis of merit. In the Research Scientist class there are no annual increments; the salary is related to the research accomplishment of each individual on the basis of an annual merit appraisal.

Senator Haig: Then the interdepartmental committee will recommend that an increase should be granted and this will go through to Treasury who will be asked to authorize the increment, or can the interdepartmental committee itself authorize the increment?

Dr. Laughland: The Interdepartmental Appraisal Committee has no executive authority. Its recommendations go to Treasury Board.

The Chairman: Would this procedure extend to all so-called professional and scientific manpower within the authority of the commission? For instance, what about social scientists?

Dr. Laughland: At the present time this applies only to scientists in the biological and physical sciences. It does not apply to engineers or to social scientists.

The Chairman: Why?

Dr. Laughland: The plan was established to apply to these people because of interest in this area. I know of no reason why it could not extend to others. But it was developed in the context of the biological and physical sciences because this group covers most of the people in the departments of government who are working in the pure sciences.

The Chairman: We have received again this morning complaints from various research agencies within departments, especially those who are working in the fields of the social sciences. People and directors of branches are complaining that they could not get the researchers they wanted at a cer-

tain prior level because they couldn't offer them a high enough salary unless they would more or less abandon research to become administrators. This complaint has been presented to us again this morning by the people in the Department of Manpower and Immigration, for instance.

Senator Haig: Then in Appendix "B" you state . . .

Senator Thompson: Continuing on Senator Haig's first question . . .

The Chairman: You can go on after Senator Thompson, Senator Haig.

Senator Thompson: Concerning the interviewing of graduate students, my question is, is there a science of selecting scientists and professional people? I say this because you see a number of independent organizations which are very successful in this for business, and they suggest that it requires certain sensitivities and knowledge and not just the fact that a fellow got good marks and has a recommendation from his professor, and so on. You have to be able to make an assessment of temperament and motivation which you cannot make on paper. Is there a science of selecting young scientists and professional people?

Dr. Laughland: In answer to your question, we have had a survey done by the Selection Procedures and Testing Division in the Commission, a literature review essentially, and on this subject the literature is voluminous. There have been something in the order of 5,000 papers published in this area in the last few years. There have been some very extensive studies done in the United States, and one large one with respect to the NASA project, but speaking generally and by way of summary, and I hope to answer your question, I would say there are no clear-cut criteria that can be used. A great deal is known about the attitudes and aspirations of a successful scientist, but trying to work back from this to recognize these characteristics in the enthusiastic and potentially capable individual who has not yet performed in research is another question. Most of these studies indicate that biographical type information is probably still the best source of data on which to base a judgment.

Senator Haig: But you could get a brilliant man at university who had excellent marks and yet who had been an absolute flop.

Dr. Laughland: This is true.

Senator Haig: Where does your personal interview come in? How long do you keep him before he fails?

Mr. Carson: There is a probationary period of one year.

Senator Haig: And then he becomes permanent?

Mr. Carson: Continuing. We try to avoid the term "permanent staff". Contrary to public opinion, there is no permanence in the public service and there are positions that are disbanded and employees released every day.

Senator Haig: Do you transfer people from one department or from one discipline to another within the government service?

Mr. Carson: Yes, indeed. Those who have had brilliant careers within a relatively specialized field are likely to stay with their discipline and with the department that originally engaged them. Agriculture, for example, has tremendous career potential for people in the particular fields that they attract. But there is movement back and forth between departments in those disciplines that are common to a number of departments. We encourage this. The system of interdepartmental competition and central inventory that the commission maintains is designed to try and encourage as much interchange and movement of personnel from department to department as is advisable. We, of course, don't encourage movement for the sake of movement but in order to enrich the mix from one department to another. This seems to be sensible.

Senator Blois: In being moved from one department to another, would that go through the commission or is it done simply between one department and another?

Mr. Carson: Anything that takes place between the departments is inevitably handled by the commission. However, departments are free to make promotions of a certain kind within the department and movement between one branch and another branch within a department.

Senator Haig: They don't need approval by you?

Mr. Carson: They operate under various degrees of delegated authority in the area, and perhaps we should let Dr. Laughland describe the various controls he has in scientific classifications. In the administrative levels, let us say below \$12,000 a year, departments have a fair amount of freedom to move people and promote them and transfer them on their own authority. When you get up to a level in which the commission really must satisfy itself that the career aspirations of other people and other departments have to be considered, at that point we try to keep a rein on the making of appointments.

Senator Haig: Before you go on with that, in Appendix "B" you say "Staffing Statistics for 1967 Calendar Year", in which you received 5,481 offers

and appointed 4,066. What happened to the other 1,415?

Mr. Carson: They didn't come with us. They turned us down.

Senator Haig: You made these offers and only got 4,066 answers. Or did the 1,415 not come to you for various reasons?

Mr. Carson: We only sent out 5,481 offers and we lost 1,415. This is pretty good experience. Major employers going into the highly competitive areas of university recruitment usually envisage that you see four students, and you make two offers for every one you get. It is a proportion of one to four. We think our ratio of acceptance has been pretty high.

Senator Haig: Then dealing on page 3 with paragraph 6, it says "Universities are the major source of supply for staff in the scientific disciplines...". How successful is this? When you go to the university and ask for courses or sciences, and here let us take an example which I don't know anything about, forestry—I suppose there are certain universities that give forestry courses. Do you encourage universities to produce this course and to find out the requirement for government service needs?

Mr. Carson: Very much so, but one of the points we make in our brief is that because of the lack of good long-range planning about the kind of direction in which scientific activity is going to go in the federal Government we are not in a position to give the sources of supply adequate lead time to be able to produce the kind of product we are going to need at the moment we need it. We are constantly engaged in crash recruitment programs to obtain a new kind of person that nobody envisaged in adequate time. We have established additional liaison officers in all major regions of Canada to keep in constant touch with universities and to keep them informed of the shifting patterns of our needs and to encourage the universities to develop a product that they knew we are going to be requiring. But I would be misleading you, senator, if I said that it was a really well organized cohesive effort. It is hit or miss—we do the best we can, we do not have enough lead time in our information on departmental needs. Departments, of course, do not have enough lead time in terms of being able to do their own long term planning.

Senator Haig: Why is this not being done?

Mr. Carson: I assume that is the purpose of your inquiry.

Senator Haig: On page 5 of your brief, paragraph 11(a), you say:

Perhaps better communication between Government planners and university officials would provide the kind of cross-fertilization necessary. . .

In other words, you have no definite long-range program in dealing with universities?

Mr. Carson: We do, but we only speak for one part of the scientific community in the public service—just the departments and agencies that are under our act. There are other organizations: there is the National Research Council, the Defence Research Board, the Fisheries Research Branch, and the Atomic Energy Commission. These are all separate employers who jealously guard their independence. So we can speak only for research and the scientific community within the traditional departments of Government.

Senator Thompson: If I could follow up Senator Haig's question: you say it is a sort of crash program when you go to a university, and you are told you will need so many more scientists, and you have to get out and get them. Is there any co-ordination, long-term forecasting, when you go to the university? When I say "you" I am referring to the members of your Commission. They probably are suggesting to university faculties: "Look, we can see there is going to be a need for some form of scientist in the future." The university will say: "Thank you for this information" and this will soak down to the students who then will enroll.

From what I can gather, there is confusion as to whether we are going to have a glut in the market on scientists. No one seems to have the facts. Where would you go to get the facts, to ensure that you are not encouraging enrolment in branches of study for people who actually may not have the opportunities in the future?

Mr. Carson: One of the problems is that the business of a university student enrolling is one of the last ditches of free enterprise in our society. The course that he chooses is entirely his own decision. He makes it upon the best hunches or whims or advice that he may get.

On the demand side, then, the employers are all fragmented. The federal Government happens to be the largest, but it is not even united in its approaches to the universities, so you have serious problems of the information being fed into the universities.

The universities now, because they have a major vested interest in the production of scientists themselves for their own purposes, either taking seriously what the demand is, (supposing it were well articulated), what the demand is going to be—perhaps shifting the emphasis because of their own special interests and somehow or other this is getting interpreted down at the university enrollment level in a

most incoherent fashion by a father or a friend. Those of you who saw that strange movie "The Graduate" will remember that classic line in which the friend of the father says "plastics, my boy".

This is the kind of vocational guidance that still goes on in this country. There are a great many chances for error and failure in this whole process and it is a wonder that we come as close to getting a match of supply and demand as we do.

Senator Thompson: But we hear, sir, that the Department of Manpower and Immigration are telling us that they put out forecasts. It was my assumption that those forecasts went through provincial governments and into high schools so that when a young fellow is graduating through high school, the counsellors—unless they are flying completely blind—when they are giving directions, I would think, to the students, they would see they are not directed into a cul de sac or something that is empty, or perhaps they are because it moves into the university level and I understand that the student has not always a hunch, that there is someone who advises him, speaking perhaps for the vested interest of a department, who will say perhaps "do not go into mechanical engineering, take civil engineering, because that is the thing of the future." You say we are applying it in darkness all around.

Mr. Carson: Not all around. The Department of Manpower, since it developed its efforts on manpower analysis, is obviously making a great and major improvement. But if you sit down and read the forecasts of supply and demand put out by the Department of Manpower, they are extremely accurate on the supply. They can tell you with precision the number of students enrolled in every course by year. But when you get into the precision of their estimates in respect of demand, it is terribly fuzzy, because employers are not used to doing this kind of manpower planning in the long term.

Let me share with you our own situation in the federal Government, because these things very often are the subject of changing attitudes and values.

In a period of austerity, when departments are under serious constraints to stay within their manpower ceilings, when you would think that it would be very easy for us to do adequate forecasting and prediction of requirements, landed on our desk right now we have requisitions for 400 economists. We have never dreamed of anything of that order in the past, and yet all of a sudden, all at once, every department wants economists.

Senator Haig: One would want a royal commission on that one.

The Chairman: Or resign from the Senate?

Mr. Carson: Ideally, we should have been telling every university in the country four years ago: "It is not plastics any more, it is economics."

Senator Thompson: Was it ever plastics?

Mr. Carson: We should have been directing a lot of young people into economics. Unfortunately, we have a long way to go in being able to do more effective manpower planning.

Senator Thompson: There are countries that have done such forecasting and are making more use of the young people moving into employment.

Mr. Carson: That is true. They tend to be a more controlled economy and have a more controlled university admittance policy. Our country and our people have not been prepared to accept that.

Senator Thompson: Where should the forecasting be done? Who should do it?

Mr. Carson: The Department of Manpower is obviously the only agency that can do this for the whole of the country. As a commission, we can do it for the departments of Government, and we try to do this. This is the reason that we have set up our educational liaison officers with all of the universities across the country, so that we can give them the most current information that we have.

The Chairman: In terms of forecasts, if you cannot forecast the needs of the federal Government, how can you forecast the needs of the nation?

Senator Haig: To get back to the 400 economists, how far in advance did the department advise you of this request. Yesterday?

Mr. Carson: Sometimes, yesterday.

Senator Haig: Should there not be some better organization than that? They must know a couple of months ahead or a year ahead, what they want?

Mr. Carson: I think that is true. But, we do not always know, of course, whether they are going to get Treasury Board approval for their estimates that they have put in.

Senator Haig: They can put in a request; they may not get it. At least you would know they have something to go on.

Mr. Carson: This is true. But more and more departments are doing their manpower forecasts in terms of man-year budgets without detailed breakdowns of so many of this kind and so many of this kind, as used to be the case.

The Chairman: The five-year forecast does not contain that breakdown.

Mr. Carson: Probably not specifically. Dr. Laughland can speak in terms of the scientific departments and how detailed a breakdown they have of the types and kinds. The economic situation that I am referring to happens to be an extraordinary one that is worrying me at the moment. I would like to assure you it is a freak.

Senator Haig: Before Dr. Laughland continues, on page 6, subparagraphs (a) and (b) you mention that the different agencies of the Government may be in competition for the same types of individuals and sometimes for the same individual. You also say responsibility is divided between too many agencies to permit an effective overall program of manpower management. What can be done to correct that?

Mr. Carson: One very simple step, if Parliament felt that it was desirable would be to reunite the scientific agencies that have been taken out from under the Public Service proper with the Public Service proper.

The Chairman: Some of them were never under.

Mr. Carson: That is right. Many of them have been independent since birth.

Senator Haig: Another question before Dr. Laughland goes on. Does the agency or department apply to you for manpower?

Mr. Carson: They apply to the Treasury Board for the position. Once the positions are approved they apply to us to fill the jobs.

Senator Haig: Do not the departments go out and try to steal a guy from the universities?

Mr. Carson: No, but they try. If we catch them we get very cross with them. You cannot have 35 departments and agencies all tramping onto the campuses of every university in the country.

Senator Haig: One of the witnesses this morning said he has gone out and spoken to a chap, I do not hope without your approval.

Mr. Carson: Of course we are not going to discourage individual initiative. If it remains at the level of softening someone up and then coming to us and saying, "Look here, I have done part of your job for you. Would you take a look at him and see, if in your view, he is just as meritorious as we think he is."

Senator Haig: Do they ever circumvent you?

Mr. Carson: They cannot. The man cannot get paid without a certificate from us.

Senator Haig: Then he can go and try and get the man and then he has to come to you and say, "I have got Joe Blow and the Treasury Board has approved this position and you go and hire him."

Mr. Carson: Yes.

Senator Haig: In the science sections of the different departments there must be a disparity in salaries.

Dr. Laughland: In the research area the system that I described for Research Scientists is designed, I would say, to eliminate this because it is truly interdepartmental and the scientists are assessed by their peers only on the basis of research accomplishment. The recommendations are made on that basis. From the standpoint of disparity I would say this does not exist in departments of Government for those individuals who are involved in research.

Senator Haig: You said, Dr. Laughland, that you have a range of high and low. Within that section of high and low there is a differential dependent upon the man's research ability.

Dr. Laughland: That is right, sir. There are four grades in the Research Scientist Class, one to four, and this is designed to accommodate the individual coming into, the new PhD, if you wish, the Public Service, from the time he joins to the time he retires 35 year later. If he wishes to stay in research the class does two things. It provides a basis for consistent treatment from the career development standpoint throughout all departments of Government. The other thing it does is it permits him to stay in research if he so wishes and he can be a productive research scientist without having to move off into an administrative type position to obtain higher salary, because the range for this class goes from—at the present time our recruiting rate is \$10,500 for a PhD up to a maximum as high as \$23,000 or \$24,000.

Senator Haig: He goes in different classes then from one to four.

Dr. Laughland: He would progress from one grade to another in research and he does not have to go out to an administrative type position to obtain a high salary. There is another Research Management Class which is designed to accommodate the productive research scientist, possibly when he reaches his mid-forties or fifties, who has become a director of an institute with administrative responsibilities. These are parallel classes.

Senator Thompson: One of the agencies came before us and, as I recall, said they did not want to have to go

through the Public Service Commission in order to recruit because of the inflexibility attached to going through your agency. How would you answer that?

Dr. Laughland: It is true, of course, that the exempt agencies such as DRB or FRB have operated over the years with their own act and they have considerable flexibility. Our procedures now with respect to selection and appointment enable us to move just as quickly as any of the exempt agencies. I can give you an example of how rapidly we can operate. We had an interview team last year at Berkeley, California. A recommendation came back and after checking with the department an offer was in the hands of the man the same afternoon.

Senator Kinnear: Mr. Chairman, I would like to answer a question. It is a paragraph you skipped over, Senator Haig. It is on page 5 at the bottom:

A shortage of human resources, once it is clearly established and known, tends to attract a very considerable amount of interest.

And then it goes on to say once you get it rolling it is hard to stop.

Mr. Carson: Indeed.

Senator Kinnear: That is what makes me think it would be very valuable if you could give some advice to the universities. It is a paragraph that you are getting too many in that discipline and probably that would tend to stop a glut in certain areas in those having too many scientists or too many chemical engineers—you do not deal in that area—or too many something else. It seems to me with your analysis you could suggest to universities when you see an overproduction of scientists or whatever it is.

Mr. Carson: We do this to the extent that we can, but the train of events really started with the high school counsellor who stated to young Jimmie when he was 16, 17 or 18, saying, "You know, organic chemistry is the thing." and so he goes off to university and pursues this kind of a career. The university is reluctant to dictate to students what courses they go into.

Senator Kinnear: They often switch them after the first year.

Mr. Carson: On a permissive basis.

The Chairman: Not according to market forecasts. They might switch them for different reasons.

Mr. Carson: Today there is a potential glut of organic chemists. At what point did we know this precisely and how much good is it to tell the

universities today? We can stop the thing getting worse, but our problem was that we should have been able to tell the high school counsellor five or six years ago.

Senator Kinnear: That would be the thing to do, to try and forecast for five or more years and to get your trends better developed. Have you thought of doing that?

Mr. Carson: Yes.

Senator Kinnear: Are you doing it?

Mr. Carson: To the fullest extent that we can. I do not want to leave the impression with you that we are just a reactive body that is sitting back responding to data that comes unto us. We are out in all departments trying to cultivate as much information as we can about the direction in which they are going and the kinds of people that they are going to need. But this is an element in personnel administration that managers have got on to only very recently. Up to recent years I think people have felt that they could let tomorrow look after itself: "We will tell you what we require when we know exactly that we require it."

Senator Kinnear: Today is changing; everything is speeding up.

Mr. Carson: That is right.

The Chairman: So far as giving that general information to the universities, this would be more the responsibility of manpower and immigration. You can give them some information so far as the federal Government is concerned.

Mr. Carson: That is right. Manpower has the job of giving them global information for all employers over the country. We want to make sure, of course, as the largest employer that we look after our own. We would be abdicating our responsibility, if we left it entirely to the Department of Manpower and Immigration. We want to make sure that the universities have as much current information and projected information as we can possibly give them. The burden of our brief is that so long as we have the utilization of scientific personnel within the central Government fragmented among a number of agencies, the degree to which the federal Government is going to be able to speak coherently to universities is going to be a little less clear than if one voice was speaking.

Senator Kinnear: I think that is what is troubling us all—the fragmentation of departments, boards and commissions.

Senator Haig: Perhaps, Mr. Carson, there is a lack of co-ordination and co-operation among the different departments in the scientific fields.

Mr. Carson: I think that would be a legitimate comment, but once you grant autonomy to people there is a preciousness—I think all of us have a preciousness in this respect—about preserving autonomy. Bear in mind that some of these agencies view themselves as our competitors, and they are.

Senator Haig: Why?

Mr. Carson: They are our competitors in the labour market. They want the best; we want the best.

Senator Haig: But you are the co-ordinating body; you are the employer.

Mr. Carson: Not for the National Research Council or for the Defence Research Board.

Senator Haig: Leave them out. What about minor departments such as agriculture?

Mr. Carson: Oh, there is no problem of co-ordination there. We speak with one voice and divide the labour pool at the university level equitably among all departments.

Senator Haig: I am relieved. I did not understand that.

Mr. Carson: Perhaps I am being a little too subtle in this brief.

Senator Haig: Well, the whole brief indicates a lack of co-operation and co-ordination in scientific planning. That is my impression. You mention a lack of co-operation between universities and you go down even to the high school level. But I would think that at the university level or maybe at the pre-university level, grade 13 in Manitoba for example, that there would be an indication that there is a field, say, in forestry, which is an example I happen to know something about, where there is going to be over the next five years a reasonable chance of employment in that service.

Mr. Carson: Well, we can do this for the Public Service, senator, at least for the part that comes under the Public Service Employment Act. The burden of this brief is to draw to your attention the fact that we have four different approaches of personnel administration for research science in the Government of Canada. We are responsible for the largest element, but there are as many research scientists put together in all the other agencies as there are under the Public Service Employment Act.

The Chairman: You would say it is about 50-50?

Mr. Carson: I think that is roughly it.

Dr. Laughland: That is approximately correct.

Senator Haig: You only handle half of them.

Mr. Carson: Of research scientists?

Senator Haig: That is what I am talking about.

Mr. Carson: Yes.

Senator Blois: You have also competition from the various provincial research foundations?

Mr. Carson: Oh, yes, and private employers as well.

Senator Haig: How does the rate of salary compare to that of industry, as a general thing? Do you lose many people to industry because of salary?

Mr. Carson: It depends on the field. In certain fields, I think it is fair to say that we lose very few to industry. But the industrial market responds more rapidly, sometimes, to shortage areas than we do and it will build up the market. The field of geology, for example, is an up-and-down thing. We do not respond as dramatically. There will be some years when we will lose in shortage areas. I think Dr. Laughland will agree that it is fair to say that salary levels in recent years have not been our most serious consideration in the recruitment or retention of scientific personnel.

The Chairman: Again, here you do not speak about the social sciences, because we have a different story from certain departments.

Mr. Carson: This is true, Senator Lamontagne.

The Chairman: We were told again this morning that salaries and other fringe benefits—which may not be fringe benefits, really—in universities are much higher than the salaries that can be offered in, for example, the field of economics in the federal Government.

Mr. Carson: I think we have to start out on the assumption that the development of the demand end in the social sciences has been fragmentary and neglected in the past in a way that we have corrected, or made great strides, with respect to in the hard sciences. We have been working at the hard sciences longer and we have learned a lot more about them. We have applied ourselves to them in a much more intelligent fashion. The utilization in the social sciences has been quite fragmented amongst a great many departments. We are making progress now, hopefully,

but we have not had the same kind of coherent information to go on, coming from a few major employing departments.

When we developed the Research Scientist Class a few years ago, we only had five key departments to work with. They were the major significant employers of research scientists. So it was relatively easy to get those five departments to work vigorously and energetically with us to create an approach to the research scientist classification and appraisal program. It was a magnificent performance of co-operation and co-ordination amongst those five departments. We have been anxious to get that same kind of coherent attack on the problem of the research scientist in the social sciences, but in the first place departmental utilization of the social scientists is not nearly so well developed or recognized and there is no experience with the management of this kind of resource, and we just have not been able to pull out of the employing departments of the social scientists the same kind of co-ordinated activity and effort that we were able to on the research scientists program three years ago.

I assure you that one of our really early objectives will be to try to come up with a comparable approach in the area of the social sciences. It will mean, of course, that the employment of the social scientist is going to have to become a much more clearly recognized and organized activity than it has been up to now.

Senator Haig: Do you have any in-service training in your commission?

Mr. Carson: Yes, we do have a good many kinds, senator. We do not train research scientists in the Commission and I realize that is your major concern. The commission's major contribution to the field of training and development is in the area of administrative training and development. We do provide administrative training courses both in residence and in classroom for all of the departments of Government. We have young engineers, young scientists, coming to learn the craft of administration; then these young men return to their departments. But this is the main job that we do in terms of centralized and co-ordinated training for all departments, and we do this at many levels, starting out with the young recruit whom we hire from university right on up to the executive training level.

Senator Haig: Thank you.

Senator Robichaud: On page 3, paragraph 7, of the brief you state that the Public Service Commission "has developed flexible methods of recruitment and selection which are highly responsive to the requirements of departments." This has to do with the

question we have just been debating. What I would like to know is what are those methods of recruitment which are so flexible, and particularly during the recruitment and selection process how much use does the commission make of the department involved?

I will give you one example. Let us say the Department of Fisheries is asking for a biologist for its oyster culture station at Ellerslie, Prince Edward Island. Now, there are biologists all over the country who have different degrees and different abilities. Who determines which of the applicants will be the most suitable for that particular position?

Mr. Carson: I think the answer to your question is going to be pretty simple, Senator Robichaud. The department probably phones Dr. Laughland and says "This is a problem" and he will probably say to them "I suppose there are only two qualified people in Canada and you probably know them." The research manager involved will say "Yes, I know them both; I can get them on the phone and find out which is available." And it will all be done in five minutes. We can do this now. Historically—prior to the passage of this last act in 1967—the act laid upon us the requirement to advertise nationally, and so we would mount these enormously burdensome competitions when the deputy head or the research manager knew there was only one person in Canada.

Senator Robichaud: You still had to advertise?

Mr. Carson: Well, we thought we had to. I can remember when I was here with the Glassco Commission talking to one deputy about this problem. He said "I am looking for a research director, and the commission told me I would have to advertise. I told them that there were only two people in the country. After two months they came back and said yes, there were only two people—one has gone to the United States and the other is still here." That was two months later. Now that could have been done with a phone call in five minutes. Fortunately the new act allows us to make appointments without running these terribly laborious competitions. The act permits us to use such other methods of personnel selection as in the commission's judgment are sufficient to ensure a meritorious selection is being made. So we can apply common sense now. It has cut the delays down enormously.

Senator Thompson: I suppose the purpose behind the national advertising was to ensure that there was no preference by someone person in the department for an associate or something.

Mr. Carson: That is true, and we still use advertising in administrative ranks. We use it intelligently when we want to know what the market is like. But in the scientific area, it is such an intimate commu-

nity in Canada, our scientists in the Government in collaboration with Dr. Laughland will know who is available. We are beating the bushes all the time, visiting the universities, visiting scientific gatherings to try and keep in touch with the labour market.

I am talking about the experienced scientist now and it really is a much simpler task to perform in the scientific area.

Senator Haig: Do you have much co-operation between the professors of graduate students who are intelligent and bright enough to become members?

Mr. Carson: Yes, this will depend, of course, on the faculty involved. I would suppose that Dr. Laughland has close ties with every agricultural faculty and every one of the scientific disciplines associated with agriculture, and this would be true in many other fields such as Forestry and Fisheries. But when you get off into the area where there are going to be many other competitors, including the National Research Council and the Defence Research Board, the departments of the federal Government have no guaranteed access to the best students. We cultivate this and we work on it, but we are just one of a number extending blandishments to professors and presidents of universities and deans and placement officers. We don't have a corner on the employment of young people.

The Chairman: Would there be the same prestige involved working in a department or working for a crown agency or would there be better working conditions working for NRC than working for the Department of Agriculture?

Mr. Carson: Well, senator, I presume you are giving equal time to the exempt agencies so I can feel free to stick my neck out . . .

The Chairman: Please do.

Mr. Carson: . . . and say under the present circumstances I don't think that we need to take second place to any of the other employing agencies in terms of prestige of work we have to offer, the interest and working conditions and stimulating work associations. We think our salaries for the most part are competitive. From time to time there will be little lags, but we don't feel we need to take second place to any of the other government agencies that are recruiting in the same market.

The Chairman: Take, for example, the flexibility of working hours. Would there be the same flexibility within a crown agency and crown corporations in the field of research?

Mr. Carson: I don't know. I know the National Research Council is terribly proud of the fact that

their people walk in at three o'clock in the afternoon and maybe go home at three o'clock in the morning. They tell this story everywhere they go. My own impression is that the same kind of person who had the same reason for doing that kind of work would find a co-operative milieu within the departments of government as well. We are not robots in the government departments. I would like to think that there is as much flexibility of management and administration in the departments of government as there is in any other research establishment. But we don't make a fetish of encouraging "kooky" behaviour.

Senator Haig: You don't go from three to three.

Senator Thompson: One of the points raised before the committee in one of the briefs or by one of the witnesses was that a scientist is at his most imaginative in research up to about the age of 35 or 40. You have explained before that you cannot fire people, and I would assume therefore that as a man grows in age he grows in responsibility within the Government, so that the bright input in scientific research is made up of the younger fellows who are not heads of departments. I suppose I am making a sweeping statement here, but am I right that it might be more helpful to be working outside of government where the head of research division may be 45?

Mr. Carson: This is true and, senator, I do think we have an opportunity here to do some imaginative thinking in the area of our superannuation arrangements. People do tend to feel locked in to our present superannuation arrangements which do not provide for retirement before age 60, except on health grounds, without accepting an actuarial reduction in pension. It does become an impediment to mobility after, let us say, the age of 50 and certainly after 55 it becomes a very real impediment to mobility.

I think there is real justification for the Government to examine the possibility of either having more flexible interchange arrangements with universities and provincial governments so that we could encourage mobility of people who perhaps have reached the peak of their creative contribution, who may not have the strengths or muscles that would enable them to go on, being perhaps less creative in a research sense, but quite creative in an administrative or managerial sense.

The Chairman: In teaching.

Mr. Carson: These are people who could go out, if they had the skills, to the university as a gifted teacher bringing with them a wealth of experience. At the present time, because of our rather inflexible

superannuation plan, this is not easy to effect. I wish it were.

Senator Thompson: Would you like to enlarge the Senate? It would help.

The Chairman: Is this a limitation that the Crown agencies do not have?

Mr. Carson: No, they are under the same superannuation plan.

Senator Thompson: I notice another thing which causes some concern. You are recruiting outside Canada and in the United States and Europe. I would suggest in would indicate that our own graduate schools are not producing the necessary people, and the question is, are we lacking in graduate schools in these particular requirements?

Mr. Carson: I should clarify that. We only go outside this country when we cannot meet our requirements within. The Public Service Employment Act lays the responsibility on the Commission to give first priority to Canadians, so we never recruit in the United States or the United Kingdom unless we can satisfy ourselves that there is a specific shortage in this field in Canada, and then we go off to the U.K. or the United States and recruit. Part of our recruiting, of course, in the United States and in the United Kingdom is to bring back Canadians. We run in co-operation with the Association of Universities and Colleges of Canada a rather mammoth operation "Retrieval" each year to try to locate Canadians who are studying abroad or working abroad and try to bring them home, so we really only recruit in the areas where the Canadian universities or the Canadian market has not been able to supply.

You asked a question as to whether we should be doing something about this in Canada. Very often, these are in fairly specific areas where, for one reason or another, the United States, the American universities or the British universities have been pioneering for so long that even if a course in a Canadian institution became mounted it would take some time before it had the prestige and the reputation of the institution in the United States or Britain.

Dr. Laughland, who has been involved in organizing our efforts at recruitment in the U.K. and U.S., may want to comment on this.

Dr. Laughland: In commenting on this question, senator, the problem as it has been indicated, is a question of specialized training to meet particular needs. As an example of this, we have just finished our Canadian recruiting at Canadian universities. About 35 universities were visited by recruiting teams and we were looking for approximately 80 scientists at the PhD level. We feel we may be able to

fill about 40 of these positions in Canada. One of the problems in some cases is that no one may have turned out to the interview. In other cases, for example in organic chemistry, we might have 20 people interested and only one position available. There are new and developing areas and I could cite the example of the Canadian Centre for Inland Waters at Burlington, which is a new program, requiring specialized training in certain areas of geology, such as limno-geology where geologists must be knowledgeable of areas surrounding lakes and the shoreline. Paleontologists are in short supply. For this reason, you have to go to the United States or in some cases overseas, in an attempt to meet specialized requirements of the federal Government program.

Senator Thompson: Could you not do this? Take, the example of Senator Robichaud and the oyster beds wanting a supply of chemists. When he was minister, he decided that this is going to be the best research division in the western world, so he got some famous person from Europe or Japan, because he knows this will attract other scientists. I understand other scientists will come if they know that there is a top man going to run the show. A man from Japan says I want \$50,000, or this would be the attraction, plus certain space, and so on. This means you are going to be flexible, because this is necessary. Would Senator Robichaud get that man, or would you say: "Look, there is a category for \$18,000 in Class 5 and that is as far as we can go?"

Dr. Laughland: With respect to the position and the instance you cite of the oyster breeding project at Ellersley, the Commission staffing officer responsible for this is a former employee of the Department of Fisheries, a biologist himself, and he would be working very closely with the departmental officials. If I could mention this in passing, the staffing officers who are involved in this professional staffing are all graduates in science themselves, operating in the field of personnel administration. The question of the individual, Senator Thompson, and his position, on the assumption that the position has been established by the Treasury Board and classified at a certain level, would be resolved by working very closely with the department in the light of any suggestions or advice they might have concerning the individual, wherever he might be. We also, from the standpoint of flexibility in recruitment operate with what we call a continuous staffing program. This is done by an announcement, usually on an annual basis, or it may be more often, indicating that the Government of Canada, the Public Service of Canada, has a requirement for biochemists, biologists, and so forth. This then permits us to maintain an inventory of individuals, anywhere, who are interested in employment with the Government of Canada. Two things might happen, in the example that you cite. The Department might come forward with a recom-

mendation concerning a particular individual. We would welcome this, and we encourage departments to do it. Conversely, we would have a look at the inventory and see what we could do. If unsuccessful, we would have to go on the open market with a special competition.

Senator Thompson: Do you have an inventory for position of Chairman of the CBC?

Mr. Carson: We have an inventory with a lot of interesting names in it, but we have not been asked to supply candidates.

Hypothetically, the research scientist classification scale has no upper ceiling, and so if that individual was really outstandingly well qualified in comparison with all other research scientists we have in the Public Service there is no barrier for him to being paid \$50,000. We have made major breakthroughs in the new approach to the administration to the research scientist category. We were able to persuade the Treasury Board not to put a top salary at the top level of the research scientist grade on the assumption that it may be in the public interest to keep someone in the research scientist community in the federal Government even if we have to pay him \$100,000. The Treasury Board went along with this, but I think they have asked us not to test or press them too far.

Senator Thompson: Would you say that the reason Canadian scientists in the United States remain there rather than come back to work for the Government of Canada is that for the most part the facilities available to them there are more important than the salary aspect?

Mr. Carson: This will certainly vary and it is pretty difficult to be precise about it. I would like Dr. Laughland to add to this because he talks to far more of them than I do, but our impression is that the major arguments they put up are the facilities and the opportunities given to them. The salary considerations do not, at least at the oral communication level, come through to us as the major or overwhelming reason. There are a number of them who I think would cheerfully accept a lower standard of living and all that goes with it for some of the psychic benefits of living back home, but our experience has been that the toughest hurdle for us to overcome are the opportunities, the equipment, the facilities and the perhaps a more challenging environment. If you feel, Dr. Laughland, that I am being too optimistic then please correct me.

The Chairman: Before you go on, you were just mentioning a moment ago that the superannuation fund, was an arrangement that could be an obstacle for people wanting to get out of federal departments.

Mr. Carson: At a certain age.

The Chairman: Could it be also an obstacle to come in?

Mr. Carson: No. We can hire people right up to 64 years of age. They do not get a very large pension, but pensions are geared to the last or the highest six years of employment. Coming in at an advanced age is really no serious handicap.

Senator Thompson: It would be an obstacle in that you do not have a reciprocity.

Mr. Carson: Exactly.

Dr. Laughland: With reference to your question, Senator Thompson, it is quite true that the salary structure we have in the Public Service now, again speaking generally, is quite competitive with industry and universities. The reason for this is that the determination of salaries in the Public Service is done chiefly on the basis of comparison with university salary curves, industry data and any data that the Pay Research Bureau may accumulate.

In speaking to the young scientist who is completing his PhD in university, we find that he is very interested in where he is going to work and whom he is going to be working with and the nature of the equipment. Toward the end of the interview he will perhaps inquire about salary. I may be oversimplifying it, but in general we are in the market and we are competitive.

With respect to students in the United States, I think that in general this is due to the fact that they wish to work at a university with some individual or in a particular laboratory where they can get outstanding training. They go to California or Wisconsin for biochemistry. They do this sort of thing because they are with the man. The same thing, though, is true in Canada. We do not have as many in a numerical sense, but we do have some very outstanding people. You find this also at the departmental level, where there are outstanding scientists in departments such as Energy, Mines and Resources, National Health and Welfare, Agriculture, and Fisheries and Forestry. Students want to work with these individuals.

The Chairman: To come back to one of Senator Haig's original questions and your first paragraph here, which we have already touched on, you say that there should be co-ordination with respect to recruitment selection and promotion techniques. Could there be more co-ordination without these agencies, which are not responsible to the Public Service Commission now, becoming responsible to you for these purposes?

Mr. Carson: We would love to co-operate. I think. Mr. Chairman, to answer your question honestly there could be more co-operation. I think we are moving in the direction of more co-operation. I was encouraged recently when the Commission decided that it would

like to have the National Film Board make a film on science and Government that we could use for vocational guidance classes throughout the country to try to stimulate youngsters to think in terms of Public Service careers in science. We realize that we could only show a portion of the picture of science in Government and I went to the National Research Council and the Defence Research Board and said, "How about coming in on a joint venture with us? Obviously, we can show to the youngsters of Canada a much more complete picture of science in the Government if we can show the things that are going on in your laboratories as well as our own." Now, I do not know, but I believe that a couple of years ago the inclination would have been, "You go your way and I will go my way; I can look after myself." In response to this inquiry there was absolutely no question that this would be a joint venture, the Public Service of Canada, the National Research Council of Canada, the Defence Research Board and the Fisheries Research Board would be listed as participating agencies in the creation of this film. They all agreed to make their facilities available so that they could be part of this film.

The Chairman: Do you have at present a pool of knowledge or of potential candidates? You certainly have one in the Public Service Commission. Do these agencies have access to that pool of information about manpower?

Mr. Carson: Absolutely, if they want it.

The Chairman: Do they have access to it and do they use it?

Mr. Carson: Dr. Laughland, my impression is that they do not make use of it.

Dr. Laughland: Yes, that is correct.

Senator Haig: Why not?

Mr. Carson: They like being independent and most people who are independent do like being independent.

Senator Haig: That is the best use of this bank.

Mr. Carson: We do not think it is. That is the purpose of our brief.

Senator Thompson: They have also an inventory. Can you make use of their inventory, and do you?

Mr. Carson: Dr. Laughland, you will have to answer that; I do not know.

Senator Haig: Chicken!

Mr. Carson: I do not know.

Dr. Laughland: I think the answer to it is that we probably could because many of these agencies have inventories of various types. The type of contact that was mentioned before between departmental scientists and university professors, were contacts made at the scientific meetings. I would think that our inventory is probably more extensive than any of the others. Certainly, if we received any inquiry, we would be only too happy to provide any assistance we could. In fact, it does sometimes happen that we will encounter candidates who are not in an area in which federal Government departments are involved, for example, some specialist area, and on occasion we refer these to the exempt agencies.

Senator Thompson: That was not really the answer I was expecting. I was asking if you would go and look at their inventories. Are you permitted to?

Dr. Laughland: I expect we would be permitted to, but we have not. We do not use their inventories, no.

The Chairman: All of them have their systems of recruitment and selection and promotion. All these agencies have their own.

Dr. Laughland: That is correct, sir. Their systems are very similar in many respects. They use appraisal boards. There is a point that could be made with reference to the claimed advantage of being exempt from the Public Service Employment Act. The exempt agencies do not use this exemption in the sense that they are violating common practice. They have restraints on hiring. They do not go out and pay \$15,000 for an individual for whom we would pay only \$10,000. This is the sort of thing I mean.

Senator Thompson: The Glassco Commission Report did not mention anything about this. Did you not quote the Glassco Commission Report?

Mr. Carson: The Glassco Commission Report said that if the Civil Service Act were amended and major changes were made, really the arguments for exempt agencies remaining outside the jurisdiction of the Public Service would come to an end.

The Chairman: This is when the big fight started—after the report.

Mr. Carson: Mr. Chairman, I find myself in a delicate position here. I debated very seriously about whether we should come out and say the things we have said to you. We feel that we have accomplished all of the changes that the Glassco Commission Report urged had to be made in personnel management—well, not all of them, but we are well embarked in that direction. We now feel that we are in a stage where the preciousness of autonomy that

seemed to be very important to some agencies and departments in the past should not be so precious a concern any longer.

Senator Haig: Hear, hear.

Mr. Carson: We think that we are in a position to co-operate with providing services to all departments and agencies of Government and that we can do it probably more completely, more economically and just as rapidly as a bunch of individual entrepreneurs going out on their own could do.

But going further than that, I do not feel is a mandate of our Commission. That will be a decision that Parliament or the Government of the day will have to make. The new Public Service Employment Act does make provision for the Governor in Council to add additional agencies or bring additional agencies under the provisions of the Public Service Employment Act. Interestingly enough, a number of agencies are already seeking to come in that direction—agencies which have been exempt from the provisions of our act for some time. We are in negotiation with a number of them to start providing employment services to them, to give them the advantages of having access to our inventories and to give their employees the opportunities of having access to career opportunities in the much larger Public Service.

Senator Robichaud: Is this not due to the flexibility that the Public Service Commission has now compared to the old Civil Service Commission which certainly had no flexibility—or very little. I remember my experience with them, and it was outrageous. I recall one incident where I sent them a letter—and unfortunately I happened to be a politician—warning them about a certain applicant to whom they were going to give a position. I warned them that after six months or so they would have to fire the man. I suggested to them that they should investigate. They looked at my letter and threw it in the basket. They refused to make an investigation. I hope this situation does not exist any longer.

Mr. Carson: I hope not. But further than that I do not want to go.

The Chairman: The trend you were describing a moment ago does not seem to be general. We will have before us tomorrow an agency of the Government which is at present a department of Government. I suppose I can refer to the brief that we will consider tomorrow where it says that corporation agency structure is the type of Government structure which will provide the greatest degree of flexibility, co-ordination and autonomy of operation.

It is just a contradiction of the statement you have been making this afternoon. So the trend is not general yet.

Mr. Carson: This is a difficult issue that you and your colleagues will have to wrestle with, Mr. Chairman. I think we have put our house in far better order than it ever was before and that we are prepared to provide service now in a much more professional effective and coherent fashion than we did in the past, and under these circumstances I think for some parts of the public service now exempt from the provisions of the act there might be real advantage in being part of the public service proper. I should mention to you that the Commission has delegated out all of the operational category which consists of 100,000 positions and virtually all of the administrative support category which is roughly now 40,000 positions. The commission's major effort from now on is going to be concentrated on doing the most efficient job of professional, scientific and executive search and recruitment that we possibly can. We may be dealing now with a constituency of roughly 40,000 positions in the public service instead of the 200,000 we were coping with in the past. Under these circumstances I think we can offer an integrated service to the professional and scientific agencies we were not in a position to provide before.

The Chairman: Does it mean that now the individual departments can recruit stenographers?

Mr. Carson: Absolutely.

The Chairman: So that now they have their own recruiting system.

Mr. Carson: Yes.

The Chairman: So we are back in the position you were trying to avoid?

Mr. Carson: No, we monitor their recruiting system and we set the standards but they go out and do the job. We merely ensure that the merit system is being maintained and that patronage, either bureaucratic or political, is not creeping in. But we feel that for the largest employer in the country it makes eminent sense to have a highly efficient, highly energetic, imaginative, specialized recruiting agency in the shortage areas where you are in toughest competition with industry, universities and other levels of government. That comes in the professional scientific and executive area. It is an area which we will specialize in to provide the best possible service to departments and agencies.

Senator Thompson: Dealing with the Manpower offices, studies have shown that in the United States instead of using Manpower offices for professional and

executive people they use much more private agencies. Do you use private agencies?

with the specialized labour market. We think we can do this better than anyone else can do it for the Government departments.

Mr. Carson: Not at all. I would like to feel that as we continue in the direction we are going our various staffing programs filled with specialists with knowledge in the particular occupational field that they are looking after are going to know more about the labour market and are going to know more about the availability of specialist resources in this country than all of the private placement agencies put together. We are now at the stage where we know more about the available supply of personnel administrators than all of the private placement agencies. They come to us and say "What can you tell us about so-and-so?" Because we have a dossier on virtually every personnel administrator in the country. We have been hiring so many of them in recent years and so many have replied to our advertisements and we have been screening them and sifting them. Similarly, Dr. Laughland and his group in the bio-physical staffing area probably know more about the bio-physical labour market in Canada than anyone else does.

The Chairman: To come back to another question that I raised a little earlier. Would it be possible, if it is not done already, to include more detailed breakdowns of Manpower requirements in the professional and scientific field in these five year forecasts?

Mr. Carson: This would be an enormous help. I wonder if I could ask Dr. Laughland if he could give us some feel of how effectively this is being done now.

Dr. Laughland: Yes, there is some information of this sort available. When the departments present their estimates each year. With respect to new programs, for example, there is an indication of the type of individual and perhaps the level of competence that they may require to conduct a program. I feel that we, the Commission, can have some real input into this with respect to shortage areas, our knowledge of shortage areas and whether or not it is actually possible to mount a program, if you do not have the people to do it.

Senator Thompson: Do you see this situation? Here you have the Government paying for Manpower offices, executive-professional Manpower offices and they are to provide both for Government as well as for private industry. You seem to have developed a most sophisticated method of looking after Government. I am just wondering whether there should not be some sort of advice given to Manpower offices to get them into a more sophisticated position and yet if you do, your competitors, private industry, quite obviously will be served as well as the Government.

Mention was made earlier with respect to forestry. At the present time, the forestry schools in Canada graduate something of the order of 150 people each year, I believe. This is a shortage area. We are competing with industry. There would be little point, I suggest, in establishing a major program, that was going to require 40 or 50 foresters tomorrow.

Mr. Carson: We do work most intimately with the Canadian Manpower centres and as we delegated out staffing responsibilities for the operational category, the blue- and grey-collar workers and the administrative support, the clerical employees—as we delegated that out to the departments, we laid on the requirement that they had to use the Canada Manpower centres to do their recruiting and the Canada Manpower centres are doing the initial recruiting for all departments of Government now. We are not proposing that recruitment in the professional scientific area and the executive area should be done by Manpower. We feel these are very scarce resources, that all employers are in tough competition with each other and it would put the Department of Manpower into a potential conflict of interest situation if we burdened them with making sure we got our fair share of the employment market. I do not think other private employers would believe that the Canada Manpower centres were giving them a fair break, because they would feel that, understandably, their first feeling of responsibility would be to us. So we are preserving the highly competitive short supply area in which you have to have intimate liaison with the universities,

The Chairman: I thought the Government decided recently to build two new research labs, one in Ottawa and one in Alberta. They may not have staff to use these facilities then.

Dr. Laughland: When I mentioned forestry I was picking a specific area.

The Chairman: It is a good illustration.

Dr. Laughland: In many others it would not apply. This is the sort of thing I think has to be done, recognition of the long term needs, and there is a great deal of co-ordination in this respect by staffing officers who are in daily contact with developmental scientists and moving back and forth discussing areas of research and new and proposed programs. We are a little bit ahead of the actual day on which the requisitions arrive in the commission to be filled and I think—

Mr. Carson: Not as far ahead as we should be.

The Chairman: Certainly not in respect to the economists.

Mr. Carson: Rather than discourage you with that illustration, which was an extreme one, I should tell you that we have this week brought together all key departments that were involved in this accumulative demand for economists. As you can imagine, this is a ridiculous situation. There are not 400 economists available in the world to come and work in Canada. We are going to have to make do with other kinds of people, but you know how fads go, all of a sudden economists are in—a few years ago it was engineers. Everybody thought they were the solution to all our problems. I am a psychologist and I am still waiting for the day when my group may be in short supply. Hopefully, by bringing departments together and pointing out to them that there is not a hope of supplying their requirements in this way you can get them to restructure their task, and explore the possibility of utilizing other kinds of people.

The classification system that the Treasury Board has established envisions a social science support sort of person. We have not experimented with this effectively in the Public Service of Canada yet. We have in DBS and we have some support kinds of people, but we have not gone to the Ryersons and the other. Institutes of Technology and said, "Produce an assistant economist kind of person," but we are starting to.

The Chairman: I do not want to pursue this too far. In the case of these 400 economists, would they be mostly engaged in research or as policy advisers?

Mr. Carson: This would be an accumulation of everything, and of course all of them with 50 years' experience.

The Chairman: And young.

Senator Cameron: I was going to ask, are you finding any change in attitudes with respect to an appreciation of the expanded role that the blue collar worker can fill in our society as opposed to the university graduate? You see, some people say you have got to have a university graduate for everything, but we know in actual practice a man from Ryerson or one of the equivalent technical schools can do the job as well or even better, but there is not just quite the prestige factor to it.

Mr. Carson: The technologist has saved our life in the Public Service during the last few years. And it probably is not just by fluke. Certainly everyone was keenly aware this was a new frontier that had to be explored, but if we did not have the output of Ryerson and the institutes of technology in the other provinces, across the country, we would be really in serious straits. I would be misleading you if I said this was an easy battle to win, because when we go in and urge departments to look at their engineering chores

or any other specialist or scientific category, they know the product of the university and they feel comfortable with that. To get them to see how you could write out certain duties and have them done by a new breed of animal, is always a battle. We have been making real strides in this and thank God we do have the institutes of technology. I visited some of them this last winter. The product that is coming out of them is marvellous. I suppose we are the largest single employer going onto the campus of the British Columbia Institute of Technology, Ryerson and others.

Senator Cameron: Is there much of a wage differential between a university graduate and a graduate of the Institute of Technology which requires grade 12 plus two years? How would that chap's salary compare with that of a B.A., just in general terms?

Mr. Carson: Some of these chaps are getting into just as short a supply situation as the university graduates are. If you take the total university graduation, liberal arts as well as sciences, the graduates of the institutes of technology are probably going to receive more offers of employment per person than the graduation classes of all the universities in the country. They have really established their product. But how do the salary levels compare?

Dr. Laughland: In general, you can equate the Institute of Technology graduate with a three-year university graduate. Pass course graduates earn approximately \$5,900 to \$6,000.

Senator Cameron: I thought it would be higher than that. I was wondering if there was much of a differential.

Mr. Carson: This may vary with category. I do not know where we would be without the computer systems people some of the institutes of technology are turning out. We would just be in desperate straits without them. Of course, their product is, generally speaking, more geared to hard work and enterprise and all of the Horatio Alger values that seem to be in question at some of the universities.

Senator Robichaud: In other words, they are more practical.

Senator Cameron: University students do not seem to like computers in some places.

Senator Carter: I have several questions, Mr. Chairman. I am afraid they are perhaps not too related, but I think the witness said just after I came in that they are now concerned with about 40,000 personnel instead of 200,000. That is because departments now hire their own help up to a certain classification level

Mr. Carson: That is the direction we are going in. We have not got rid of all of the 160,000 yet. We are up to about 130,000 now.

Senator Carter: Do you have any figures on the median salary of that 40,000? How would that compare with 200,000? What has happened to it?

Mr. Carson: I probably have that in our annual report.

The Chairman: Well, in general, I suppose that you are trying to get rid of classifications involving blue- and grey-collar people and are concentrating on professional and scientific personnel. That will give you a range of salary to work with.

Mr. Carson: I can work this out. Unfortunately, our annual report which gives a distribution of all employees in the Public Service by salary levels does not give me, without some arithmetic, the exact variation that you are looking for. I suppose, if I were to take a rough stab at it, it might be \$10,000 as opposed to \$6,000.

Senator Carter: That would be the median or the average?

Mr. Carson: I think the average.

Senator Carter: You said you monitored what goes on in the departments when they recruit. Do you do any monitoring about their ratings, the ratings each department does? I understand we have a whole variety of departments and they all have different systems with regard to ratings. Does the commission concern itself in that at all?

Mr. Carson: We are concerned about it very much. We don't have statutory authority, but we have a very real interest in it because in our central inventories for the 40,000, for example, we hope to retain on a central basis in what is going to be a meaningful way the appraisal information coming from the department about people and it has to be good, consistent and usable. If different departments were using different rating systems and different approaches to appraisal we would be in a chaotic state. That aspect of our inventories would be meaningless. We are very careful about this; we are attempting to produce guidelines in conjunction with Treasury Board which will be issued to all departments in the hope of getting uniformity of approach across the board. I have to confess that you are right and that departments have been left to use their own individual initiative in this field. The commission did send out a recommended approach to performance review back in 1962, but it had no teeth in it. Some departments picked it up and are using it, and others thought it was more fun to go out and invent the wheel for themselves and they have taken

different approaches so that there is a wide variation of practice at the moment. Both the personnel policy branch of Treasury Board and ourselves are seriously concerned. We have just completed a joint study of what is being done in all departments and we were a little shocked to find out how widespread a variation there was, but I can assure you that hopefully with good will and co-operation we will work ourselves out of this one.

The Chairman: I would like to excuse myself as chairman at this moment. I thank you, Mr. Carson, and your colleagues at least for the time being because I am wanted at another committee and they are waiting for me. I will ask Senator Cameron to take my place.

(Senator Cameron assumed the Chair.)

Senator Carter: I have just one more question, Mr. Chairman. I think the witness said that the Public Service Commission has accumulated a lot of information about personnel administrators and classifications like that that private agencies now come to them.

Mr. Carson: Not officially.

Senator Carter: I was wondering. If this information is confidential and you have private agencies coming to you—

Mr. Carson: It is confidential, but you know when you are out sleuthing around the country and meeting a lot of people and they phone you on the "old boy" network and ask "What can you tell me about so-and-so? We understand you didn't hire him." This is what I mean when I say they are coming to us for information.

Senator Carter: But they are not coming officially.

Mr. Carson: No, no, I am sorry; I misled you there. They just recognize that we happen to know more about certain specialist areas of talent in the country than they do. They are depending upon putting ads in newspapers, and I think they get to know the people in their community very well, but they don't usually have the kind of Canada-wide information about specialized classifications that we have.

Senator Thompson: I always have a certain apprehension about the privacy of the citizen when you speak of this "old boy" network and giving information about people.

Mr. Carson: I call them for references too, sometimes, senator.

Senator Thompson: I am thinking of credit cards and everything else we have in computers. I am sure

that does not mean that someone is blackballed because your people did not take particular liking to them and therefore it spread throughout the community.

Mr. Carson: No, I can assure you that we are extremely cautious in anything we do say, and anything we have received of a confidential nature of course we would not be sharing at all.

There is a large number of professional job hoppers in the country, of course, and they are the ones people are most interested in finding out about.

The Acting Chairman (Senator Cameron): May I again express our appreciation to you for coming and giving us this information.

Mr. Carson: Senator Cameron and your colleagues, we are very grateful to you for giving us an opportunity to share these thoughts with you and for your interest and your patience which has encouraged us greatly. Thank you.

Senator Haig: It has been one of the most thought provoking briefs we have received.

Mr. Carson: Thank you, sir.

The committee adjourned.

APPENDIX 30

A Brief

to

THE SENATE OF CANADA

SPECIAL COMMITTEE ON SCIENCE POLICY

Presented by the

Public Service Commission of Canada

November 1968

Special Committee

BRIEF TO THE SENATE OF CANADA
SPECIAL COMMITTEE ON SCIENCE POLICY
BY THE
PUBLIC SERVICE COMMISSION

SUMMARY

The Public Service Commission, in carrying out its statutory responsibilities to meet the requirements of government departments for scientific and professional personnel considers the following points of particular significance in the development of a national science policy:

1. There should be coordination with respect to recruitment, selection and promotion techniques between government departments and agencies primarily involved in scientific research.
2. Manpower inventories and staff appraisal techniques should be standardized to provide comparable information with respect to all scientists in the public service.
3. There is a need for increased liaison between the universities and the federal government, as a major employer of scientific personnel, in order that long-term planning may be effective in relation to the use of manpower resources.

The Public Service Commission in Perspective

1. The Public Service Commission is directly responsible to Parliament with respect to its statutory responsibilities under the Public Service Employment Act. The present act came into force on March 13, 1967 along with the Public Service Staff Relations Act and certain amendments to the Financial Administration Act. These legislative changes have had a more profound impact on personnel management in the public service than any other change since the Civil Service Act of 1918. The new legislation resulted from the recommendations of the Royal Commission on Government Organization, the report of the Preparatory Committee on Collective Bargaining and the deliberations of the Special Joint Committee of the Senate and the House of Commons on Employee-Employer Relations in the Public Service.

2. With the introduction of a collective bargaining system, the responsibilities of the Civil Service Commission for such matters as pay, classification and conditions of employment became inappropriate for an independent Commission. Under the new legislation these responsibilities were transferred to the Treasury Board and the Public Service Commission is now able to concentrate its resources on activities directly related to the efficient staffing of the public service under the merit principle.

3. The Commission does not provide direct financial support for scientific research carried out in federal government departments but it does devote a major portion of its resources to activities that result in the appointment of the scientific and professional staff required to perform such research. Appendix "A" provides information with respect to the organization of the Commission and particularly those segments concerned with staffing in the scientific and professional areas. The scope of staffing activities for 1967 is given in Appendix "B".

Operational Aspects of Staffing

4. The staffing function includes recruitment, selection, employee appraisal, transfers and promotions. The Staffing Branch of the Public Service Commission is organized into a number of "Programs", each Program being responsible for a family of related occupational groups. Three staffing programs, the Applied Science Program, the Bio-Physical Sciences Program, and the Social-Economic Program, share the staffing responsibilities for the applied, pure and social sciences respectively. These programs are comprised of officers who are responsible on an interdepartmental basis for a number of disciplines related to their own area of professional jurisdiction. Appendices "C", "D" and "E" provide information concerning the responsibilities of these programs and some of their major interests.

5. A planning directorate which operates in an advisory capacity supports the staffing programs. The Selection Standards Division, for example, creates selection standards which parallel the revised scheme of position classification being established by Treasury Board; the Delegation and Monitoring Division develops monitoring and auditing systems for actions taken under delegated authority; and the Management Information Service provides data on manpower needs and resources within the public service. All manpower inventories of the Staffing Branch are being integrated into a system known as, "Data Stream", which will permit a more rapid identification and effective use of available human resources

through the use of an on-line computer. In addition, the Test Development Section is responsible for the establishment of procedures whereby the attributes and skills of employees may be quantified and presented in a form suitable for comparative purposes. In similar fashion a Staff Training and Development Bureau is concerned with the assessment of training needs and the introduction of training and retraining programs in order that manpower resources may be used with greater effectiveness.

6. Universities are the major source of supply for staff in the scientific disciplines and increased and improved liaison could well result in new forms of cooperation which would benefit the country as a whole. The Public Service Commission has already appointed regional educational liaison officers in order that there may be more direct and continuing contacts between the Commission and the universities. These officers are aware of the courses being offered by the universities and technological institutes and are able to bring the federal government's staffing requirements to the attention of university authorities. In addition, the educational liaison officers are of great assistance in introducing new plans or activities to the university community in their region and are in an admirable position to participate in the overall recruitment, selection, and appointment functions.

7. Conscious of the admonition in the Glassco Report that: "effective conduct of the nation's business should brook no delay because of unnecessary procedural complexity in recruitment", the Public Service Commission has developed flexible methods of recruitment and selection which are highly responsive to the requirements of departments. Insofar as the quality of these operations is concerned, the Commission is confident that it compares favourably with any other organization, public or private, engaged in this same activity. Appendix "F" provides staffing statistics for some professional classes.

8. The Research Scientist and Research Manager classification and pay plans are of particular significance with respect to the research activities of federal government departments. The Research Scientist Classification and Pay Plan, which was introduced by the Commission in October, 1965, provides for the advancement of scientists on the basis of research accomplishment as determined by an annual appraisal. Under this merit system the outstanding scientist can be adequately rewarded whereas the less meritorious individual

receives little or no monetary increase. There is a financial control established by Treasury Board but apart from this constraint there is considerable flexibility with respect to salary determination. The introduction of this plan has been a distinct advantage in attracting and retaining well qualified scientists in the public service and a similar pay plan, but with some notable differences, is used for research scientists who have assumed positions involving the management and direction of research programs. The Research Scientist and Research Manager classification and pay plans enable the Commission, in cooperation with the Treasury Board, to provide consistent personnel administration for all research scientists in the departments of government. The distribution of research scientists and research managers by department and grade is given in Appendix "G".

9. The availability of these plans together with the use of modern and effective recruitment and selection techniques means that appointments can be made with a minimum of delay and effective service provided to all government departments. Indeed, progress has been such that it would perhaps be valid to consider if scientific agencies not included under the present Public Service Employment Act could not now, in the words of Glassco, "be quite happily reunited with the older, traditional departments and agencies in a unified public service". Certainly the economies to be gained in both human and material resources argue in favour of a more unified service which would be more responsive to national science policies and would permit equitable treatment for all federal government scientists.

National Priorities, Science Policy and the Public Service Commission

10. Several of the eminent scientists who have appeared before this distinguished committee have alluded to the importance of qualified people in the development and implementation of science policy. Professor Arthur Porter expressed it succinctly as follows:

"When we talk about science policy, we are talking about people, and how best they can be utilized and put in the right sort of environment so that they are going to create."

Because human resources are essential to the development of scientific research, it follows that they must be considered and given priority in the earliest stages of policy development. Since it is the Commission's role to find and develop the human resources necessary for the effective

implementation of science programs within the framework of a system of national priorities, one cannot help but be aware of certain problems which exist in the absence of a national science policy. The following areas are of particular significance and merit serious consideration.

The Relationship Between the Consumers and Suppliers of Talent

11. There are three main users of talent: the government, industry and the universities, but there is essentially only one supplier: the universities. The relationship between supplier and user should be symbiotic, but to describe the existing situation as ideal would be misleading. Of primary concern to the Commission is the relationship between government and the universities and a few syndromes may be recognized:

- (a) Because the universities are consumers of their own products, there is the possibility that they can become the centre of a self-sustaining supply and demand cycle. The "ivory tower syndrome" may manifest itself in out-dated courses providing training which finds little application outside the university and represents, potentially, a severe wastage of human and material resources. Perhaps better communication between government planners and university officials would provide the kind of cross-fertilization necessary to ensure that a cycle of this type does not get started, and this without doing violence to the spirit of independent inquiry that the universities uphold so well.
- (b) The more exciting areas of scientific research tend to generate a great deal of interest and may stimulate universities, government departments or agencies and industry to begin or expand investigations in identical areas. The "me too" syndrome may, on occasion, be productive from the standpoint of scientific research but it brings with it the very considerable risk of so dispersing available talent that progress is in fact delayed.
- (c) A shortage of human resources, once it is clearly established and known, tends to attract a very considerable amount of interest. University output may increase, recruiting outside the country is stepped up, and even a new cycle of immigration may result. Unfortunately, these activities have a tendency to continue

independently of any change in the supply and demand situation.

The machinery may be slow to start, but once it is operative it is very effective - and very difficult to stop. The "too much too late" syndrome may result in a wastage of human resources that we can ill afford.

The Nature of Government Staffing Activities

12. While the Commission can take justifiable pride in its staffing operations, it is necessary to recognize the need for improvement in certain activities. The public service has been criticized on occasion as being cumbersome in action and inflexible in adapting to new situations. We have been slow to initiate the type of aggressive, imaginative and responsive recruiting and public relations methods necessary to attract a generation of students which is more interested in challenge and change than it is in security and routine. But we are making progress, we are attempting new things, and applying greater intelligence and competence than we have done in the past to these problems. We have within our staffing branch more technical and administrative competence than we have ever had before and the results are encouraging, new approaches are being developed and implemented and these are proving themselves in use. However, certain problems require greater study:

- (a) It is perhaps inevitable that on occasion various scientific agencies of government may be in competition for the same types of individuals and sometimes for the same individual. To what extent the national interest is damaged or served by this competition in the market place is very difficult to assess. One suspects that each staffing agency would be happy to recommend that the others defer to it and anomalies are created when different selection standards, salary scales and manpower inventory systems are used.
- (b) The location, identification, selection, recruitment, development and retention of first-rate talent requires a unified approach that is rational and coherent in both its design and its operation. This has not been achieved, nor is it likely to be achieved until the total staffing function is integrated into a national priority and policy network. At the moment, responsibility is divided between too many agencies to permit an effective overall program of manpower management.

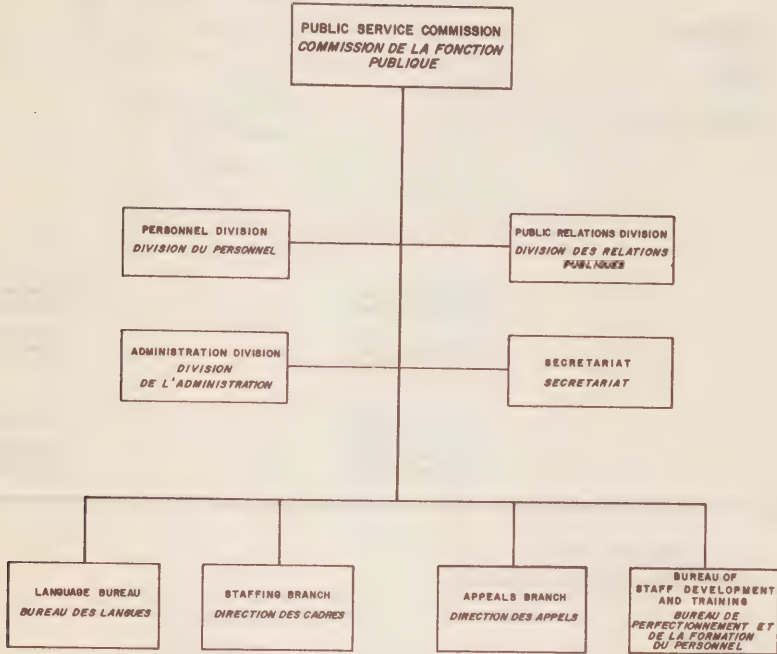
The Unique Role of the Universities

13. The universities are both custodians and developers of a very significant portion of our national human resources and consequently the policies followed by the universities will, inevitably, have considerable impact on our ability to marshal the right kinds of talent at the right times in order to achieve our national objectives. The universities must remain centres where thought can develop freely along original lines but they must be aware of national needs and priorities and contribute in a major way to the formulation and implementation of a system of national goals. As a recruiting agency, the Commission is attempting to identify future manpower needs in order that available data are used as wisely as possible in meeting objectives. There would appear to be a need for greater cooperation and coordination among the universities themselves, and greater participation by the universities with government and with industry in the formulation and implementation of national policies and priorities.

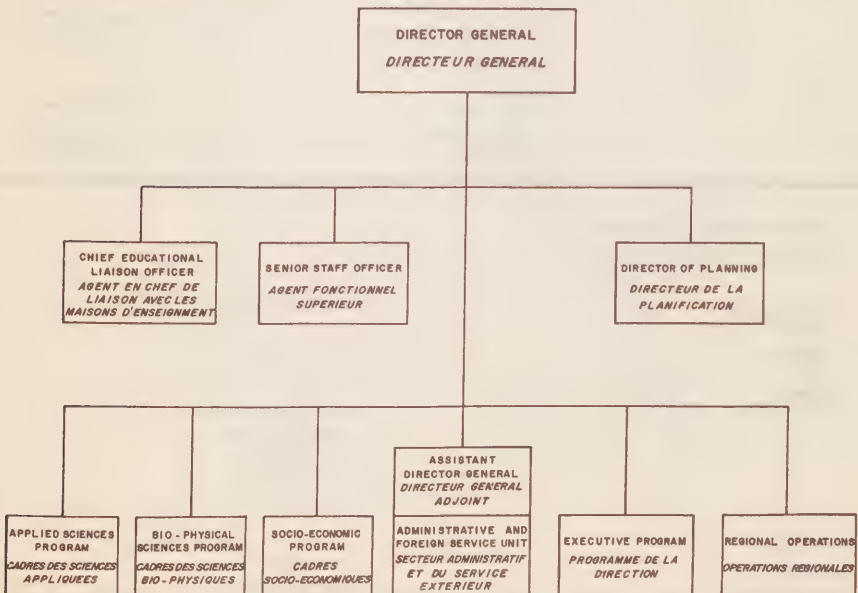
14. In conclusion, it is considered from the staffing point of view that research and development activities carried out by the federal government will be most effective under conditions of coordinated personnel administration. There is also a need for increased liaison between the government and the universities with respect to the current and long-term use of scientifically trained personnel.

Appendix "A"

PUBLIC SERVICE COMMISSION
COMMISSION DE LA FONCTION PUBLIQUE



STAFFING BRANCH
DIRECTION DES CADRES

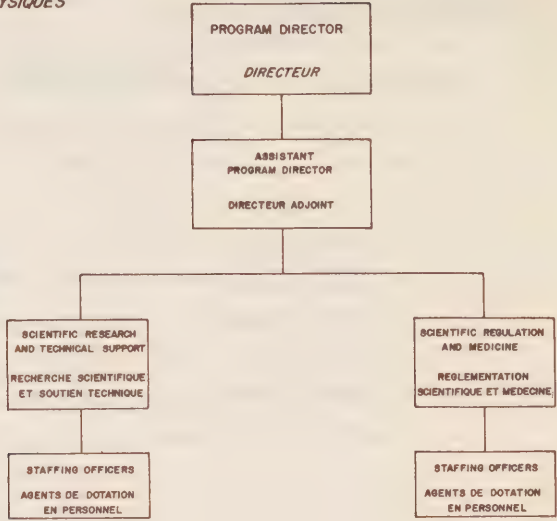


BIO-PHYSICAL SCIENCES PROGRAM
CADRES DES SCIENCES BIO-PHYSIQUES

ESTABLISHMENT
EFFECTIF 25

OFFICERS
AGENTS 11

SUPPORT
PERSONNEL DE SOUTIEN 14

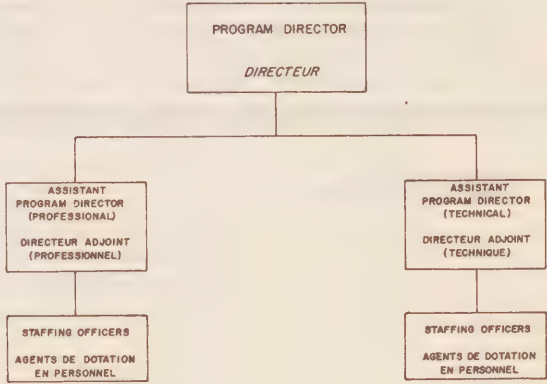


APPLIED SCIENCES PROGRAM
CADRES DES SCIENCES APPLIQUEES

ESTABLISHMENT
EFFECTIF 26

OFFICERS
AGENTS 12

SUPPORT
PERSONNEL DE SOUTIEN 14

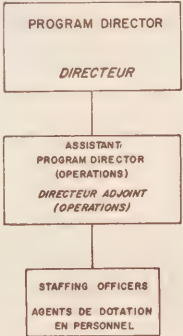


SOCIO-ECONOMIC PROGRAM
CADRES SOCIO-ECONOMIQUES

ESTABLISHMENT
EFFECTIF 33

OFFICERS
AGENTS 17

SUPPORT
PERSONNEL DE SOUTIEN 16



Appendix "B"

STAFFING STATISTICS FOR 1967 CALENDAR YEAR

Program	Applications		Offers		Appointments	
	Number	% of Total	Number	% of Total	Number	% of Total
Admin. & Foreign Service	20,595	43.2	1,782	32.5	1,976	48.6
Applied Science	8,423	17.6	1,329	24.3	537	13.2
Bio-Physical Sciences	8,467	17.7	1,197	21.8	767	18.9
Social-Economic	10,286	21.5	1,173	21.4	786	19.3
TOTAL	47,771	100.0	5,481	100.0	4,066	100.0

APPLIED SCIENCES PROGRAM

The Applied Sciences Program is responsible for staffing activities in the following occupational groups:

Engineers
Architects
Aircraft Operations
Air Traffic Control
Drafting and Illustration
Electronics
Radio Operatio.
Ships Officers
Ships Pilots
Engineering Support
Technical Inspection

The Program has been relatively successful in meeting departmental requirements for professional and technical staff, although some difficulty has been encountered in recruiting personnel with specialist training.

The following aspects are of particular concern to the Applied Sciences Program:

- (a) Engineers are involved in a variety of projects such as satellite communications, water pollution studies, the development of international airports, and roads in the north, and there is an increasing demand for specialist training.
- (b) In addition to the traditional role of architects, there is an increased demand for people experienced in landscape architecture and rural planning.
- (c) The institutes of technology are distinct from, but complementary to, universities and vocational schools and the graduate technologist bridges the gap between the professional and the technician or skilled craftsman.
- (d) An extensive program of recruitment at universities, institutes of technology and colleges of applied arts and technology permits the Applied Sciences Program to meet its major objectives. It is anticipated that the demand for professional staff will exceed the supply for the foreseeable future and greater use will need to be made of technologists and technicians.

Appendix "D"BIO-PHYSICAL SCIENCES PROGRAM

The Bio-Physical Sciences Program is responsible for staffing activities in the following occupational groups:

Agriculture	Physical Sciences
Biological Sciences	Scientific Regulation
Chemistry	Scientific Research
Dentistry	Research Scientist
Forestry	Research Manager
Home Economics	Veterinary Science
Medicine	Scientific Support
Meteorology	General Technical
Nursing	Primary Products Inspection
Occupational and Physical Therapy	Technical Inspection
Pharmacy	

It has been possible to meet departmental requirements in most occupational groups in a satisfactory manner but shortages still exist in forestry, veterinary medicine, mathematics and some specialist areas in the physical sciences.

The Bio-Physical Sciences Program has a major concern with the following aspects of staffing:

- (a) Scientists trained in the biological and physical sciences are involved in a variety of projects being carried out by the scientific departments of government. In addition to basic research, these include regulatory and service aspects required in the development of our natural and human resources and in the protection of the public health.
- (b) Very extensive recruiting campaigns have been carried out since 1964 in Canada and the United States, and for the past two years in the United Kingdom and Europe.
- (c) A Career Introduction Program has been established for outstanding students who are interested in summer employment. Under this plan a carefully selected group of students will be provided a unique opportunity to work in highly skilled and career oriented environments. This plan involves a high degree of cooperation between government departments, the universities and the Commission.
- (d) The Institutes of Technology and Community Colleges are now providing excellently trained technologists and technicians and recruitment is very active and successful in these areas.

SOCIAL-ECONOMIC PROGRAM

The Social-Economic Staffing Program is responsible for staffing activities in the following occupational groups:

Economics, Sociology and Statistics	Education
Law	Historical Research
Mathematics	Library Science
Social Work	Psychology
Welfare Programs .	University Teaching
Translation	Commerce
	Social Science Support

While shortages exist in most groups, considerable success has been achieved in meeting departmental requirements. At the present time, three occupational groups provide the greatest problems - Economics, Sociology and Statistics; Library Science; and Translation.

In order to alleviate the shortages in these groups in particular, as well as in the other groups shown, the Social-Economic Program is currently engaged in several projects:

- (a) A continuing program of visits to universities is underway in an attempt to gain further knowledge concerning the university student population. In addition, discussions are held with faculty members, placement officers and students to outline career opportunities in government service.
- (b) Discussions are held with university faculty members concerning training in special areas. For example, consultation with York University regarding "energy economics" has resulted in the establishment of a graduate level course in energy economics which will be offered beginning in the fall of 1969.
- (c) Two programs involving the sponsorship of students at university are currently underway:
 - (i) Librarians-in-training
 - (ii) Translators-in-training
- (d) Overseas recruitment campaigns, in the United Kingdom and France in particular, are conducted for economists, statisticians and translators.

Appendix "E"

- 2 -

- (e) A program designed to encourage married women to return to the labour market, in certain serious shortage areas, was begun last year. While the initial success of this program was not great, it is felt that further efforts are warranted.
- (f) Internship programs involving summer employment for students in economics, sociology and statistics have proved successful in introducing students to work in the federal public service, and a number of very competent persons have been recruited as a result of the program.

Appendix "F"

STAFFING STATISTICS FOR SOME SCIENTIFIC AND PROFESSIONAL CLASSES

CLASS	NO. OF POSITIONS	NEW APPOINTMENTS			OTHER APPOINTMENTS			TOTAL APPOINTMENTS			SEPARATIONS		
		1965	1966	1967	1965	1966	1967	1965	1966	1967	1965	1966	1967
1. Architect	177	21	12	37	38	27	40	59	39	77	15	12	12
2. Bacteriologist	71	17	9	12	13	14	11	30	23	23	8	13	6
3. Biologist	195	28	35	49	38	44	39	66	79	88	5	7	13
4. Chemist	193	41	37	24	60	41	17	101	78	41	26	13	22
5. Dental Officer	76	11	5	12	1	1	3	12	6	15	11	11	7
6. Economist	483	34	47	90	67	107	123	101	154	213	18	24	30
7. Engineer	2068	174	238	290	319	382	413	493	620	703	130	114	136
8. Food and Drug Officer	188	24	29	20	54	47	48	78	76	68	10	11	16
9. Librarian	251	19	33	45	42	49	57	61	82	102	19	17	29
10. Meteorologist	360	8	13	16	82	56	70	90	69	86	13	6	14
11. Meteorological Officer	287	25	53	45	104	106	94	129	159	139	19	19	28
12. Medical Officer	529	40	50	47	60	55	62	100	105	109	36	40	54
13. Patent Examiner	200	15	28	23	41	49	39	56	77	62	20	13	4
14. Professor	193	36	31	36	33	26	41	69	57	77	33	23	30
15. Research Scientist	1531	5	57	125	1	1290	236	6	1347	361	1	28	73
16. Research Officer (Agr.)	155	67	33	24	183	154	13	250	187	37	48	22	16
17. Research Officer (For.)	188	30	49	50	34	83	17	64	132	67	25	8	8
18. Scientific Officer (E.M.R.)	275	33	45	43	31	76	29	64	121	72	21	13	15
19. Solicitor	165	10	13	30	35	36	3	45	49	53	10	6	11
20. Statistician	451	39	48	105	88	104	147	127	152	252	32	21	21
21. Veterinarian	540	35	27	31	64	67	52	99	94	83	38	28	34
22. Welfare Officer	849	21	17	-	39	46	-	60	63	-	14	8	3
TOTALS	9425	733	909	1154	1427	2860	1574	2160	3769	2728	552	457	582

RESEARCH MANAGERS AND RESEARCH SCIENTISTS - SEPT. 9, 1968

Distribution by department and grade

DEPARTMENT	RESEARCH MANAGERS Number of Staff			RESEARCH SCIENTISTS Number of Staff			
	R.M. 1	R.M. 2	R.M. 3	R.S. 1	R.S. 2	R.S. 3	R.S. 4
AGRICULTURE	9	13	40	136	483	75	14
FORESTRY AND RURAL DEVELOPMENT	4	16	11	114	141	14	3
NATIONAL HEALTH AND WELFARE	-	2	3	26	51	10	1
SECRETARY OF STATE	-	-	-	9	12	2	-
INDIAN AFFAIRS AND NORTHERN DEVELOPMENT	3	2	-	8	12	1	-
ENERGY, MINES AND RESOURCES	1	8	21	98	245	60	11
TOTAL	17	41	75	391	949	162	29



First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 30

THURSDAY, FEBRUARY 13th, 1969

WITNESSES:

Medical Research Council: Dr. G. Malcolm Brown, Chairman; Dr. J. Maurice LeClair, Member, Dean of Medicine, University of Sherbrooke; and Dr. Robert B. Salter, Member, Surgeon-in-Chief, Hospital for Sick Children, Toronto.

APPENDIX:

31.—Brief submitted by the Medical Research Council.

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Grosart	Nichol
Belisle	Haig	O'Leary (<i>Carleton</i>)
Blois	Hays	Phillips (<i>Prince</i>)
Bourget	Kinnear	Robichaud
Cameron	Lamontagne	Sullivan
Carter	Lang	Thompson
Desruisseaux	Leonard	Yuzyk
Giguère	McGrand	

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

Thursday, February 13th, 1969

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Blois, Bourget, Giquère, Kinnear, Leonard, McGrand, Sullivan and Thompson — 9.

In attendance:

Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

MEDICAL RESEARCH COUNCIL:

Dr. G. Malcolm Brown, Chairman;

Dr. J. Maurice LeClair, Member; Dean of Medicine, University of Sherbrooke; and

Dr. Robert B. Salter, Member; Surgeon-in-Chief, Hospital for Sick Children, Toronto.

In attendance:

Dr. James M. Roxburgh, Secretary, Medical Research Council.

(A curriculum vitae of each witness follows these Minutes).

The following is printed as Appendix No. 31.

Brief submitted by the Medical Research Council.

The Council has submitted the Annual Report on Support of University Research 1967-68 in support of their brief. This has been retained by the Committee as an exhibit.

At 1.00 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

BROWN G. MALCOLM Born in Campbellford, Ontario, July 16, 1916 Education: M. D., C. M., Queen's University, 1938 Rhodes Scholarship 1938 D. Phil., Oxon, 1940 Research Scholar, Radcliffe Infirmary, 1941-43 Higher Professional Qualifications: M.R.C.P. (London), 1943; F.R.C.P. (C), 1946; F.A.C.P., 1949; F.R.C.P. (London), 1961; F.R.S.C., 1966 Military Service: R.C.A.M.P., England and Northwest Europe 1943-46 University Appointments: Queen's University: Associate Professor of Medicine, 1946-51 Professor of Medicine, 1951-65 Member of Senate, 1949-52 Member of University Council, 1949-52 Member of Board of Trustees, 1966- University of Ottawa: Professor of Medicine, 1965- Hospital Appointments: Kingston General Hospital: Attending Physician, 1946-65 Director, Clinical Investigation Unit, 1961-65 Kingston Military Hospital: Consulting Physician, 1946-65 Department of Veterans Affairs, Kingston District: Chief of Service – Medicine, 1946-65 Ottawa General Hospital: Attending Physician, 1965- Ottawa Civic Hospital: Consulting Physician, 1965- Scientific and Professional Societies: College of Physicians and Surgeons of Ontario – Member of Council 1949-58 President 1956-58 Royal College of Physicians and Surgeons of Canada – Member of Council 1954-58 and 1960-66 Member of Executive 1956-58, 1964-66 President 1962-64 American College of Physicians – Regent 1965- Canadian Foundation for the Advancement of Therapeutics – Director 1963- National Cancer Institute of Canada – Representative Member 1965 Ontario Cancer Treatment and Research Foundation – Member, Advisory Medical Board 1966- Muskoka Hospital Memorial Research Fund – Chairman, Research Committee 1965- Member, Advisory Panel of the CIBA Foundation, London, England, 1966- Fellow, Royal Society of Canada Member: American Society for Clinical Investigation American Federation for Clinical Research American Society of Hematology Canadian Association of Gastroenterology Canadian Physiological Society Canadian Society for Clinical Investigation Member: Ontario Medical Association Canadian Medical Association International Society of Hematology American Clinical and Climatological Society Government Agencies: Defence Research Board – Panel on Arctic Medical Research Member 1947-54 Chairman 1952-54 Defence Research Board – Panel on Nutrition Member 1952-58 Defence Research Board – Defence Medical Research Coordinating Committee Member 1967- Department of National Health and Welfare – Canadian Council on Nutrition – Member 1950-54 National Research Council – Member 1965- Medical Research Council 1960- Member of Executive 1961- Chairman 1965 – Science Council of Canada – Member 1966- Publications: Seventy-odd papers in scientific journals in the fields of malaria research, cold physiology, hematology and gastroenterology.

LECLAIR J. MAURICE Born in Sayabec, Quebec, 1927 Education: B.Sc., McGill University, 1947 M.D., C M., McGill University, 1951 M.Sc., University of Minnesota, 1958 Higher Professional Qualifications: F.R.C.P.(C); F.A.C.P., C S.P Q. Hospital

Appointments: Hopital Notre-Dame, Montreal Attending Physician, 1958-65 University Appointments: University of Montreal Associate Professor of Medicine, 1962-64 University of Sherbrooke Professor and Chairman, Dept. of Medicine, 1965-68 Vice-Dean of Medicine, 1967-68 Dean of Medicine, 1968—Scientific and Professional Societies: Royal College of Physicians and Surgeons of Canada — Co-chairman, Committee on Credentials Association of Internists of Province of Quebec - Secretary, 1962-65 National Cancer Institute of Canada — Member, Board of Directors Member: Alpha Omega Alpha Society Canadian Medical Association Association de Medecins de la Langue française Societe medicale de Montreal Montreal Medical-Chirurgical Society Member: American college of Physicians Club de Recherche clinique de Quebec American Association for the Advancement of Science New York Academy of Science Government Agencies: Medical Research Council — Member, 1967—Member, Executive Committee, 1968—Chairman, Grants Committee for Clinical Investigation, 1968—Publications: Sixteen papers in scientific journals in the fields of internal medicine and hematology.

SALTER ROBERT B. Born in Stratford, Ontario, December 15, 1924 Education: M.D., University of Toronto, 1947 M.S., University of Toronto, 1959 Higher Professional Qualifications: F.R.C.S.(C); F.A.C.S. University Appointments: University of Toronto: Clinical Teacher in Surgery, 1955-59 Associate in Surgery, 1959-62 Assistant Professor of Surgery, 1962-1966 Professor of Surgery, 1966—Board of Governors, Wycliffe College Hospital Appointments: Hospital for Sick Children, Toronto: Orthopedic Surgeon, 1955-57 Chief of Orthopedic Surgery, 1957-66 Surgeon-in-Chief and Senior Orthopedic Surgeon, 1966—Research Associate in the Research Institute 1966—Consultant Appointments: Ontario Society for Crippled Children (travelling clinic) Ontario Crippled Children's Centre, Toronto Ontario Hemophilia Society, Medical Advisory Board Grenfell Labrador Medical Mission, Board of Directors Shriners' Hospitals of North America, Surgical Advisory Board Scientific and Professional Societies: Member: Toronto Academy of Medicine Canadian Medical Association Ontario Medical Association Royal College of Surgeons of Canada Canadian Orthopedic Association American College of Surgeons Member: American Academy of Orthopedic Surgery Association of Bone and Joint Surgery Interurban Orthopedic Club of the U.S. and Canada International Orthopedic Club Australian Orthopedic Association Government Agencies: Medical Research Council of Canada Member 1967—Member, Grants Committee for Clinical Investigation Publications: Forty scientific papers or books in the field of orthopedic surgery.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Thursday, February 13, 1969.

The Special Committee of the Senate on Science Policy met this day at 10.00 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, we are pleased to meet again with the Medical Research Council of Canada. Unfortunately, when they were first before this committee, I was not able to chair the meeting because of ill health.

Dr. G. Malcolm Brown, as you all know, is Chairman of the Medical Research Council of Canada, and he is accompanied by Dr. J. Maurice LeClair, Dean of Medicine, University of Sherbrooke, and member of the Council; Dr. James M. Roxburg, Secretary of the Council, and Dr. Robert B. Salter, Surgeon-in-Chief, Hospital for Sick Children, and member of the Council.

As usual, we will have a brief opening statement from Dr. Brown, and then we will proceed to the usual discussion period.

Dr. G. Malcolm Brown, Chairman, Medical Research Council of Canada: Thank you, Mr. Chairman, Honourable senators, the brief that our Council has submitted is, I am sure, familiar to you. I might now just mention briefly, in a summary fashion, some of the chief points which have been made.

As you are aware, the Medical Research Council is now that part of the government structure through which by far the greatest part of the federal support for medical research goes to the universities. The purpose of the operation is the improvement of the health of Canadians through the development of research. This purpose is sought through three subsidiary goals, if you like, and these are, first of all, the contributions to new knowledge that will accrue from the research; the support of the educational process in professional fields related to health by the support of the research component of the educational process; and the provision and support of that part of the technological

back-up of health care which can be provided by research.

The Council itself is a group of 21 men, and it is a working council rather than an advisory council. It is a council which has authority, within the limits of its assigned mission, to make its own policies and to make regulations, and it has authority to make decisions with respect to the spending of the money which has been voted to it by Parliament. It is, I should like to emphasize, a working council rather than simply an advisory council. In its work it is now spending about 70 per cent of its sums in the support of research programs in the universities, medical schools and hospitals across the country.

The second largest component of the effort in terms of money is concerned with the support of research trainees, people who are themselves training to become researchers in this field, and people who are training for other fields, but are seeking the benefits of a year in a research laboratory.

Until recently the training program people have had the highest priority and it has been possible to support them to the limit of high quality demands on them. At the present time they continue to have the highest priority within the Council list of programs, but it is not possible to give them the degree of support that was once given. The Council seeks to support research in a number of other ways in addition to the grants-in-aid of projects and the various training programs, of which there are a number of subdivisions, as you know, in addition to these things the Council carries on a number of other activities, under the heading, in your brief, of Special Programs. These are concerned particularly with the development of research in special situations; they are concerned with the provision of support in situations which do not fit into the run of the other major programs. It is under this heading that special attempts are made to support the development of research in new medical schools, and to support the development of research in those schools where there is concern about its present level.

Now, Mr. Chairman, as you have seen from the brief there has been some consideration given not only to the organizational basis for the Council itself, but also

to the general framework for science in the government into which the Council fits, and would fit. As has been stated in the brief, it is the strong and unanimous opinion of the Medical Research Council that the corporate agency structure is the organizational structure which is appropriate to it and which will best permit it to do its job. It is the structure which will mobilize for the job to be done the greatest number of the best people, and here again I might refer to the fact that it is a working council rather than simply an advisory council.

As it looks to the other aspects of government organization for science, it perhaps had in mind what is quite apparent in the health field, that science is inseparable from other things. Science is part of health, and an attempt to make a clear-cut division between what one might call science and non-science within the health field is something that is bound to be arbitrary and to some extent artificial.

As the Council has thought about the arrangements for science in the government as a whole, and therefore, as it has thought about the umbrella under which it will work, it has had in mind the parallelism perhaps with economics. In many ways the problems to be faced are the same. The views of Council have been set out at a little length in the brief. To summarize them here I might say that they contain the suggestion that the first thing to be done perhaps is to decide on social goals, and after that to decide on the extent to which progress towards a particular goal can be made in a scientific fashion; and, as a third step to determine the extent to which programs will depend on further and new research in the field. This is a view then which maintains that science and research are not ends in themselves, but are servants of their goals. It would follow from this, and for many other reasons also, that decisions about the application of science and about the support and development of research must be taken really in relation to the larger goals, that is they must be taken by non-scientists for the most part. A proportion of the government members and a proportion of senior administrative people have a background in science and know some of its limitations as well as its possible accomplishments. We have thought that perhaps a large part of the present problem is that this proportion is as small as it is. We would expect that, when the proportion who have a working knowledge of the scientific method is as high as it is with respect to economics, part of this problem will be resolved.

The Chairman: You are very optimistic, sir, because from what we hear about economics—and we have been told in this committee about the organization of economic research within the government—it is far from being satisfactory from the point of view of a former economist.

Dr. Brown: It has been reassuring to the scientists, Mr. Chairman, to hear people in other major fields

castigated and derided in the same way that we often are. The problems in the two fields amount to the application of what arises from a discipline to the ordinary problems of life, and I am sure the Chairman would agree, despite what may have been said about the value of economic advice, that as much of it as possible must be brought to bear on the decision points, and this would seem to be the case in science. This means that we do not think that science is something that can be put in a corner and treated all by itself, not for administrative reasons, but because, by its nature, it is inseparable from those things that are expected from science. We have made remarks in the brief, as you know, Mr. Chairman, concerning the way in which science advice might be arranged in different areas.

Finally, in the first part of our brief we have a few remarks about some immediate problems in the health sciences area. We have started from the point that Canadians seem to have made it perfectly plain that they want a high level of health care. One of the most important contributions which research and the research effort can make to the provision of such high-level care is to provide for the shortening of the gap between the acquisition of new knowledge and its application where it is used; that is the shortening of the time gap between the discovery in the laboratory and its application at the bedside or in the office or in the community. There are some problems here because of the size of the effort in the research field. This is not yet large enough properly to complement the educational job that has to be done by the medical schools; it is also not yet large enough to serve one of the other main goals of the Council which I have mentioned, which is to support adequately in a research way the technological back-up to health care.

In addition to these general things there are obviously a number of special problems which concern us, and mention has been made of just two of these by way of illustration. One of these illustrations concerns the field of bio-medical engineering. This is a field in which there is much to be done, as is the case with many fields, but this field has also the characteristic of having in it a number of people with the competences and with the desire to do things. It is a field, then, that is ripe for advance. It is a field that may be of particular importance to Canada because of the interface it may provide between medical research in the academic setting, and research and development in industry.

The second example chosen concerns another interface, that between health science research and sociology and economics. This is the relation between the acquisition of knowledge and its transmission in education, and the actual provision of health care. There is in our view a large amount of work to be done in the way of operational research in part, and it is our view that this is just as much a necessary complement

of medical research, taking the nation's effort as a whole, as is the development and production in factories of various products which arise from innovations and inventions of laboratories.

These, then, Mr. Chairman are the chief points of the written brief which has been submitted to the Committee.

The Chairman: Thank you very much, Dr. Brown. Now we will proceed to the discussion period and I will ask Senator Sullivan, whom I am sure you know very well, to initiate that discussion.

Senator Sullivan: Mr. Chairman, members of the panel, honourable senators: Thank you, Mr. Chairman, for again asking me to open the discussion before the Medical Research Council. This happened on March 21, 1968. I was just thinking while I was sitting here of the smallness of the delegation that is appearing before us compared to some that we have had, and probably that is the reason for such excellent quality.

Now, there are certain things, Dr. Brown, that you mentioned in your excellent resume. On page 1, paragraph 3 . . .

The Chairman: Before you go on Senator Sullivan, would it be agreeable if we were to make a clear distinction, during our discussions, between the activities and the functions and responsibilities of the Medical Research Council, and deal with that first, and then reserve perhaps the part of the brief which deals with science policy in general for the second part of our discussion. I think it would make for a better discussion.

Senator Sullivan: Yes, sir. Then, we turn then to pages 17 and 18, the functions of the Medical Research Council, the paragraph at the bottom of page 17 and over on to the top of page 18. I will read that:

The Medical Research Council has until recently operated as an autonomous agency within the framework of the National Research Council; it has therefore had the statutory powers and functions provided in the National Research Council Act and has reported through the National Research Council to the Chairman of the Privy Council Committee on Scientific and Industrial Research. Under an interim arrangement made in August 1968 (Order-in-Council 1968-1709), the Medical Research Council is now a separate body reporting to the Minister of National Health and Welfare; it continues to function as before pending legislation establishing its statutory powers and functions for the future.

I think, Dr. Brown, you might enlarge on that a little bit.

Dr. Brown: Mr. Chairman, as is set out here, the legislative basis of the Medical Research Council for a number of years was a little unusual in what might almost be termed its informality. From 1960 to 1968 its existence was based on a Cabinet Minute directing the National Research Council to set up an autonomous Medical Research Council within its own administrative framework. This followed on the Farquharson Report which had been sought earlier by the Cabinet of the time. This meant that the Medical Research Council was within the administrative framework of the National Research Council and reported through the same lines. Then, with the reorganization and the redesign of reporting channels which took place last summer, the decision was taken that the Medical Research Council should report to Parliament through the Minister of National Health and Welfare. If this goal was to be served it meant then a separation of the Medical Research Council from the administrative framework of the National Research Council. Very temporary arrangements have been made concerning this and we have operated under these since last August. They are of such a nature that they really could not persist for very long, and the plan of the government is to provide a legislative basis, a basis in legislation, for the Medical Research Council, and, as I have said the view of the Council is very strongly that this should be legislation which would make it a corporate agency.

The Chairman: Isn't there some kind of contradiction of views there?

Senator Sullivan: I was just going to ask that, Mr. Chairman.

The Chairman: Oh, I am sorry.

Senator Sullivan: Go ahead. That is fine.

The Chairman: You say that science must be very close to policy and be in a position to advise and all this, and here you are asking to get away from departments.

Dr. Brown: Yes. I think that one must keep the matter of levels in mind. There are policies, the matter of policy in the integration of different policies and the assignment of functions, and then there is perhaps the matter of operation and the carrying out of what has to be done if these functions are to be served. With the Council more in the health stream as far as policy-making is concerned, and working through the Minister of National Health and Welfare, the task of coordination of policy may be made easier and the coordination may be more effective, not that it has been ineffective by any means in the past; but when one comes to carry out the job that has to be done under a given policy the difference between the nature of the jobs to be done is such that we feel quite defi-

nity that there is a need for separation in operation—not separation in policy but separation for purposes of good operation.

Under the corporate agency structure our own experience has demonstrated, and the experience of other councils of the sort in Canada and elsewhere, that this can be very flexible: it can be quick in its responses to needs, it actually provides easier means of developing agreements over a term with other agencies in the field than the departmental structure does, and, finally, it is terribly economical. Our administrative costs are of the order of one per cent a year of the money administered. The figure is too small, the staff is too small, but this can be taken as a measure of the economy which can be gained using this method of procedure.

Senator Sullivan: Mr. Chairman, adding to what Dr. Brown has just stated, if you turn to page 15 it certainly must be very economical because the Council members all serve without remuneration for a period of three years with the possible renewal of their appointment for one additional term. How many Council members are there, Dr. Brown? You say they are a working council?

Dr. Brown: Yes. There are 21 and they are a working council. At the present time Council membership means the presence in Ottawa of a Council member for at least three weeks during the year, and the work that he must do in his own city or in his own town in addition to this is a matter of more weeks. When a man has to serve on the Executive and do other various jobs, then the amount of time in Ottawa rises beyond the three weeks. It has become a major job and is not something that can be taken casually any longer.

Senator Thompson: This three weeks, is that over a period, or does it take three weeks at one time in Ottawa? I understand there is a great deal of work involved.

Dr. Brown: Mr. Chairman, I meant a total of three weeks during the year, not three weeks on end but a total of three weeks as a minimum during the year. In addition, most of the members have additional duties that will bring their time spent to a level that is higher than that.

Dr. LeClair has served on the Executive and he might speak to us from personal experience.

Dr. LeClair: Mr. Chairman, Honourable Senators, I believe that as far as I am concerned

The Chairman: We have simultaneous translation that can be used.

Dr. LeClair:as far as I am concerned personally, I believe that the time I spent in Ottawa, over the

past year, amounts to about four to six weeks in addition to the work I performed at home. However, I feel it fair to mention that, as regards the members of the Council, as regards the research workers in the faculties of medicine, the efforts thus devoted are considered one of the most satisfying activities both from the educational and intellectual point of view. The importance of research in medical education is such that it is absolutely essential for us to have access to this information, and be acquainted with this group of scientists who decide on policy, and who distribute the funds voted by Parliament. Therefore, even if it does take a great deal of time, I feel that, without exception, the people who perform this task do it with pleasure, that it is a two-way street, and that everyone benefits personally.

Senator Bourget: Dr. LeClair, are there any particular research programs which interest you more than others?

Dr. LeClair: Do you mean personally, or . . .

Senator Bourget: Personally, or in conjunction with other research workers in other universities. I am thinking, for example, of the Faculty of Cardiology of Montreal; are you interested in this in any special way?

Dr. LeClair: Are you referring to the Medical Research Council or to our committee in particular?

Senator Bourget: Well, the relations of the Medical Research Council with those other branches of research such as the cardiology branch.

Dr. LeClair: Yes, definitely. For example, as you are aware, the Montreal Heart Institute has performed nine heart transplants. They were obliged to stop because of a major problem, the problem of money. The Medical Research Council has a serum, called an antilymphocytic, which is possibly one of the answers to the problems of rejection which has so greatly troubled the people of the Heart Institute. These people are consulted and are part of our research committee.

Senator Bourget: Do you assist this Institute financially?

Dr. LeClair: As far as I know there is no financial aid given directly to the Institute. However, these research workers, the research workers of the Institute, receive funds for research through grants. There is no grant per se which goes to the Institute.

Senator Sullivan: Mr Chairman, Senator Thompson asked a very pregnant question, but we must remember, Senator Thompson, that the medical profession is used to working for charity all its life—but now, under Medicare, it won't have to do that!

Senator Thompson: I cannot argue with the doctor. He took my tonsils out, and he may take more out of me!

Senator Sullivan: On page 1, paragraph 3, you have stated, Dr. Brown, that the Medical Research Council provides 60 per cent of the extramural funds reaching the medical schools from all sources. Has this always been the case? What has been the rate of growth of the Medical Research Council's budget in the last ten years?

Dr. Brown: No, Mr Chairman, it has not always been the case. In the total funds going to the support of medical research across the country there has been a considerable re-arrangement of sources during the past ten years. Our own budget ten years ago was, for example, about \$2 million, and in fiscal 1968-69 it is \$26.9 million. Other contributions to the extramural funds for medical research have not been increased at the same rate at all, for various reasons. At the present time, as Senator Sullivan has mentioned, the MRC's budget is 80% of the federal contribution, and 60% of the total from all sources. Ten years ago the Medical Research Council was contributing only about 20 per cent of the money going into the schools from all sources for this purpose.

Senator Sullivan: Thank you. Then page 43, Table 5: naturally you do not provide funds to all applicants who seek them. Can you explain in more detail how you set standards?

Dr. Brown: Well, this is the essence of a large part of the work of the Council and its committees, the setting of standards, and, as a result, the making of decisions about individual applications. Applicants for funds in support of research projects are referred externally, and then they are given consideration at length and in depth by one or more Grants Committees. It is within these Grants Committees that the standards are both applied and, to a large extent, developed. The standards are those of outstanding workers in the field. The members of the committees are men who are themselves engaged in the fields concerned. They are men of reputation, men whose own work is of international standard. It is then the standard of what is good throughout the world from the point of view of intrinsic scientific merit that is applied in the assessment. The standards then are developed within these Grants Committees, which are really working groups of experts in the field concerned.

Senator Sullivan: Can you give us any idea of the award rate in 1969 and 1970?

Dr. Brown: In 1969-70?

Senator Sullivan: Yes, projected.

Dr. Brown: It is going to be low.

Senator Sullivan: Why?

Dr. Brown: We are, of course, in the midst of that operation, but it is going to be a good deal less than 50 per cent. It is low not because the percentage of outright rejections has gone up: it is low for other reasons. In any list of applications, of course, there are always some that the Committees reject and say "No, we wouldn't support that even if funds were unlimited"; these are what we call the outright rejections. Then there is a group of applications which the committees would like to see supported, but for which there are not funds. This is the group that has been growing over the last three years, and it has been growing because of the growth taking place in the medical schools, because of the increase in the number of highly competent researchers in various places across the country, and because the funds allotted to us have not been growing at the same rate.

The gap then between what the Council would like to support because of its merit, and what it is able to support in the light of its funds, has been increasing.

Senator Sullivan: Thank you.

Senator Thompson: Could I follow on that and ask another question, or should I wait?

Senator Sullivan: No, go ahead.

Senator Thompson: I just wondered: in your award rate, Dr. Brown, it seems to me that if you are going to be taking responsibility for pharmacy and dentistry—at page 69 I think you refer to that—and the Department of Veterans Affairs is coming under your orbit—I am sorry if I am going ahead of you, Senator Sullivan.

Senator Sullivan: No, it is all right; you go ahead.

Senator Thompson: In view of what you say about it being low, is this dangerously low?

Dr. Brown: Mr Chairman, it is too low, yes—it is too low. To take these different items, if I may, for a moment, the taking over of federal support of research in dentistry was accompanied by a transfer of funds, again in rather too small amount—a transfer of funds from the National Research Council effective at the date of the transfer of support. With pharmacy the support which they had been getting before was relatively small, and it stays small although it has grown a good deal since they have been under our wing.

As regards the word "dangerously," what does it mean? I can say that one expects that during fiscal 1969/70 we will be able to give awards to only about a third of the applications for new projects, and this despite the most rigid limitation on the support to be given ongoing work. With the policies that we have had to set up for fiscal 1968/69 we have told the committees that if they want to give increased support to something that is already ongoing, they must remove some degree of support from something else that is ongoing; they must find room for the expansion of support of what is good within the total operation of what is ongoing; even with that, the money that is left over for new projects, new people, is of the order which I have mentioned, and in our view is far too low.

Senator Thompson: Thanks.

Senator Leonard: Mr Chairman, to come back to the 60 per cent that the Medical Research Council is giving of its support for medical research, on your figure of \$26 million that would leave about \$17 to \$18 million from all other sources in Canada, and that, to my mind, seems a low figure, although I accept it. I think you must have your figures correct. When I think of the Atkinson Foundation, the McLaughlin Foundation, the Bickell Foundation and others, the amount seems small. I don't know what the basis for your figures is—perhaps you might give us that—but I was really concerned to know, with regard to this total overall amount for medical research in Canada, how does it compare per capita, or by some measure, with, say, the United Kingdom or the United States? Would you have anything along that line?

Dr. Brown: Yes, Mr Chairman. About the first points which were raised, the Atkinson Foundation and the Bickell Foundation expenditures were in these figures.

Senator Leonard: Yes.

The Chairman: In order to get the picture more clearly in my mind at least, I think you said previously that your budget, your grants, constitute 80 per cent of what the federal Government is giving?

Dr. Brown: Yes in 1968/69.

The Chairman: Yes. So that that would leave only 20 per cent for the private sector and the provinces?

Dr. Brown: No, Mr Chairman. It is 80 per cent of federal expenditures in the field, but it is only 60 per cent of the grand total for the field from all sources: voluntary agencies, foreign agencies and so on.

The Chairman: But if you add the other grants given by the federal Government to your 60 per cent, how would it come, the total contribution of the federal Government to medical research?

Senator Leonard: It would be 75 per cent of the total.

Dr. Brown: 75 per cent.

The Chairman: That would leave 25 per cent.

Senator Leonard: Twenty-five per cent for the private sector, you might say. This seems to me to be a very good point, and I would just like to pin it right down so we know where we stand in Canada.

Senator Sullivan: To see how low it is.

Senator Leonard: Twenty-five per cent from the public for medical research in Canada does not seem to be a very large amount.

Dr. Brown: That other 25 per cent is made up of 21 per cent from other Canadian sources and 4 per cent from American sources.

Senator Leonard: Rockefeller, or some of the other medical concerns.

Dr. Brown: Yes. The American sources include American Government sources, which are now about \$1.2, \$1.4 million a year.

Senator Leonard: Have you something then on the comparison of total overall government and private sectors in the United States and in the United Kingdom relative to our total overall figure?

Dr. Brown: Mr Chairman, in the case of the United States the total figure is higher by a factor of the order of five to seven, on a per capita basis.

Senator Leonard: That is, they contribute seven to five from us—of what we would contribute?

Dr. Brown: They contribute five to seven times more from all sources.

Senator Leonard: Five to seven times more per capita than we do.

The Chairman: In the United States.

Senator Leonard: In the United States.

The Chairman: Than we do here.

Senator Leonard: And anything on the U.K.?

Dr. Brown: As regards the U.K., it is harder to get figures. It is higher, but, as you well know, there is a great deal of voluntary money in the U.K. A lot of it is not easily visible, is not easily traceable.

Senator Leonard: Yes.

Dr. Brown: And one doesn't know the volume there, but taking the visible money, it is higher.

The Chairman: You mean there is a black market?

Dr. Brown: A black market in charitable foundations, yes!

Senator Leonard: Thank you very much.

Senator Sullivan: I am certainly glad we brought that question out. On page 1, paragraph 1, Dr. Brown, you stated in your brief that the assigned aim of the Council is the improvement of the health of Canadians through the development of research. Can you explain more fully just how the expenditures of the Medical Research Council contribute to the health of Canadians?

Dr. Brown: Yes, Mr. Chairman. They contribute because of the research that they support, through the additions to knowledge that are made and that arise out of the projects supported by the Council; there are many examples of this, concrete examples that one could cite. Then there is the improvement of health that comes from the improvement of education, and here I would like to ask two of my colleagues, if I may, to speak, two of them who are still in medical schools. Dr. Salter, who, as has been mentioned, is the Chief of Surgery at the Hospital for Sick Children in Toronto, might speak to this.

Dr. Robert B. Salter, Surgeon-in-Chief, Hospital for Sick Children, Toronto, Member, Medical Research Council of Canada: Thank you, Mr. Chairman. I think perhaps we should point out to those present that the three doctors who are here all have very different roles in life. Although we all started out as MD's, as doctors, we are different types of people now. Our Chairman, Dr. Brown, is in fact a scientist-administrator; Dr. LeClair, is Dean of a medical school, and is a scientist-teacher-administrator; and I in my role at the University of Toronto and the Sick Children's Hospital am really a surgeon-scientist-teacher. So we all have different types of activities. But to answer the question about patient care, this is something in which I am involved as a surgeon who looks after patients, as well as a scientist who does investigation, and a teacher who teaches undergraduate and postgraduate students—I am perhaps a little closer to the actual care of patients.

I think if we go back to the turn of the century and look at something that Sir William Osler said—and Sir

William Osler, as you know, was probably Canada's most distinguished physician—he said at that time that the practice of medicine is an art based on science. Now, the art of medicine is still tremendously important, but the science of medicine on which all this is based needs to be expanded a great deal. We often hear the argument, those of us who are involved in experimental surgery and experimental medicine and so on, that “you are ivory-tower people” and “you are not really concerned about patients;” But we are indeed concerned about patient care, because all of the knowledge that accrues from medical research does in fact eventually come back to the patient.

Perhaps I should point out that there are many different types of research: there is basic research that is involved, say, in the nature of cells and the nature of particular tissues, and some of this is not strictly applicable to patients' problems but may well become so in time. Then there is the type of research that is clinically applied research, or research applied to a specific problem, and, if I may, I shall perhaps enlarge on that a little bit. A practising clinician sees a problem, say, in a given disease, and there is as yet no satisfactory answer to the problem. He starts what you might call a research cycle or circle in which he thinks about that problem, thinks about possible solutions, develops a hypothesis, and then through experimental design does research that hopefully then leads to a better understanding of the problem, that develops concepts or principles in relation to the behaviour of tissues; and then this will come back, through a better understanding of all this, through a solution to the problem, to better patient care. We have many examples of this in our major teaching hospitals throughout the country, and if later you would like to have one specific example that is perhaps very, very easy to portray, I would be glad to give that. However, I go on at the moment to speak about clinical investigation, which is another type of investigation entirely. This is investigation not with animals but with patients, and, of course always within the rules and regulations of morals and ethics, which definitely leads to improved patient care and not only the care and treatment of patients but also better diagnosis of patients and, perhaps, even more important, the research work in this country and other countries leads to the prevention of disease, to the prevention of some of the problems that our ancestors and our forefathers, and even our own parents, had to cope with.

This is another very important aspect of the benefit of research in this country to the individual patient, and this is really what it all comes down to.

[Translation]

Dr. LeClair: Mr. Chairman, I should like to bring forward the point of view of the medical professor, and the importance of medical research in medical education, if we consider its importance for the health of Canadians. I feel that we are all in agreement that a

certain number of well trained doctors and medical people are necessary in all the medical professions. Now if tomorrow morning, the aid we receive from the Medical Research Council of Canada were taken away from us, we would have to close our medical schools. The importance of what we receive from the Medical Research Council is such that a medical school, today, in Canada, could not function without this aid. Why? Because a large part of the education of a doctor, dentist, pharmacists or other medical professions, a large part of this education, I repeat, is comprised of research, of medical information. New discoveries are being made so rapidly. For example, it is said that every seven and one-half years, there is a complete revolution in medical information which one must be capable of assimilating in the rest of one's lifetime. And for this information, one must have developed what is called a feeling for research. This groundwork necessary for teaching in all the faculties of medicine is possible solely because of full-time research workers. If I may take the liberty, Mr. Chairman, I should like to mention that the importance of what I am saying is emphasized by the presence here this morning of Dr. McLeod who is Executive Director of the Association of Canadian Medical Colleges; the very presence of Dr. McLeod here indicates the importance of research in medical education.

The Chairman: However, you are not exaggerating at all when you say that, if the subsidies of the Medical Research Council were cut off, the medical schools in Canada would close?

Dr. LeClair: Mr. Chairman, I am not exaggerating in the least. I shall give you an example. In Canada, we would not be able to keep a single person in the pure sciences, let us say a biochemist, who did only teaching if he could not do research. 80 percent of these persons' time is devoted to research with the rest of the time devoted to the teaching of what they learn or of the techniques they learn through research. This is true to such an extent that we are advancing further and further towards a point where 30 percent of medical education will be in the form of what are called elective courses, that is, the student himself chooses an aspect of a certain field in which he wishes to specialize. It is only with the research workers that we have that we are able to keep these electives. I am not exaggerating. I am convinced that I reflect the opinion of all 16 deans of the faculties of medicine in Canada. Furthermore, I believe that Dr. McLeod could well confirm what I have just said.

[Text]

The Chairman: That is a very good answer.

Senator Sullivan: Yes, excellent.

Senator Thompson: Mr. Chairman, just on the last remarks, may I read from page 32, where it says:

During the present year, the four new medical schools have had first claim on half the \$750,000 devoted to Negotiated Development Grants.

That is the four new medical schools, and in view of the last speaker's remarks it seems to me, you know, that there is again this tremendous shortage of funds. Half of \$750,000 is \$375,000 for all the other medical schools, and yet you refer to the fact that if you don't have research facilities you really don't have medical schools, you cannot attract people. I have read the report here of MRC., which perhaps in my Irish way I would call a dangerous situation for the health of the people if we don't get research which is linked to the medical schools. I notice, as I say, on page 34 it will really cripple all our medical schools if something isn't done to get finances for them, for your research facilities.

Senator Sullivan: And shortage of staff.

Senator Thompson: Yes.

Senator Sullivan: The same thing. Are you going to answer that? Do you want to?

Dr. Brown: No, I agree very much with what Dr. LeClair has said, and I agree too with the assessment that has been given of the situation. It is a precarious situation.

Senator Sullivan: Mr. Chairman, I have two brief questions that I would like to ask now. I have a few more, but I will stop after these two.

Enlarging on what Senator Thompson said previously, on pages 21 and 22 you say that the Department of National Health and Welfare also has a responsibility to support medical research. How are the two programs co-ordinated—and also that of the Department of Veterans Affairs?

The Chairman: Yes, could we enlarge on this, Senator Sullivan, and ask Dr. Brown what are the federal agencies which are offering grants—all the agencies?

Senator Sullivan: That is fine.

The Chairman: Offering grants in the field of medical research at the moment.

Dr. Brown: The Department of National Health and Welfare, the Defence Research Board and the Department of Veterans Affairs.

The Chairman: This is the other 20 per cent. What would be their relative contribution as compared to yours?

Dr. Brown: Yes. In 1968/69 the Department of Health and Welfare will be spending approximately \$5 million, a bit over.

Senator Leonard: May I interrupt? Does that include equipment?

Dr. Brown: That does not include the Health Resources Fund.

Senator Leonard: But it does include machines, for instance?

Dr. Brown: The Public Health Research grants do include some equipment, but this figure does not include the Health Resources Fund figure; it represents money spent by way of grants.

Senator Leonard: Yes, that is obvious. The Health Resources Fund is of the order of \$37 million.

Dr. Brown: Yes, but only part of that is for equipment. There will be some major equipment in this \$5 million coming through Public Health Research grants, but only the usual proportion of the grants operation. The other figures are very much smaller: the Defence Research Board just over \$600,000 for 1968/69, and D.V.A. just over \$400,000. Then the National Research Council also gives a small number of grants to workers in medical schools; these amount to something over \$300,000 a year. Those are the figures, Mr. Chairman, for other federal support of medical research.

The Chairman: Would you evaluate also the budget that NRC devotes to medical research—to intramural medical research?

Dr. Brown: How would I evaluate it?

The Chairman: Yes.

Dr. Brown: At a dollar figure?

The Chairman: Yes.

Dr. Brown: It is reported by itself, I believe, to be about half a million.

Senator Sullivan: Dr. Brown, you say that the Department of Veterans Affairs has asked the Council to assess its applications for grants. Why?

Dr. Brown: I think, Mr. Chairman, there are two or three reasons. If grants are to be assessed properly and standards maintained—high standards developed and then maintained from year to year—it is necessary to have a certain volume of grants, and the operation must be of a certain size. Their operation is perhaps borderline in this respect. Also I suppose this was something of a compliment. The Council and its committees have developed a reputation in this field for both rigour and fairness I think, and, as a result, the DVA made this request for assessment of merit. They

have, in addition, to make an assessment of relevance to their particular mission. That is something that they will do themselves. That is something we will not touch; they will do that themselves.

The Chairman: Have you anything further?

Senator Sullivan: All right. I will have a few questions later.

The Chairman: Just in there, to follow that immediately, and I will recognize you afterwards, Senator Sullivan, if the DVA grants are being now integrated in your system, what about trying to integrate also other grants programs?

Dr. Brown: Yes. Mr. Chairman, first of all it is just the assessment that is being requested.

The Chairman: Yes.

Dr. Brown: Not the administration, or the definition of mission, or relevance, or those other things.

The Chairman: We seem to have all kinds of committees working all over the place. There might be some undesirable duplication. I understand that some duplication may be desirable, but there might be some undesirable duplication.

Dr. Brown: It would be my view that it is highly desirable to have more than one possible source of funding. It is highly undesirable to double-fund a given project from more than one source, and a great deal of time and effort is spent in making sure that this does not happen. But we have absolutely no objection—indeed, in some cases we encourage it—to an individual investigator applying to more than one of these bodies at the same time for support of the same research. It is up to us to sort out our responsibilities, and this is done at the staff level, to make sure that the man is adequately supported if he deserves it, and is not over-supported.

As regards the other bodies that have been mentioned: in the case of \$5 million operation of Health and Welfare, obviously there is sufficient volume here for it to be done from that point of view without any problem at all. The Defence Research Board operation, like the NRC operation in the grants field, is carried out as part of a larger scheme, and therefore the question of volume which I raised first of all in the earlier remarks does not apply here.

The Chairman: Why? You must have somewhere some committee of experts for that immediate purpose.

Dr. Brown: Not quite, Mr. Chairman. In the case of NRC, for instance, the grants that are made to medical schools are decided upon by committees which have

very much larger responsibilities than the grants to medical schools. The decisions, the assessments of them, are made by committees with very large responsibilities, committees with standards and so on. The decisions regarding grants to medical schools are not made by a segregated committee in the National Research Council, so that that problem does not arise, the problem of difficulty of assessment because you are assessing so few; it does not arise there.

Dr. Salter: Dr. Brown, may I make a comment at this time about autonomous organizations? We could draw an analogy between the administration of all research, we will say even all medical research in Canada, and all of medical schools. You can go back a little to the time when every doctor was a physician and surgeon: now there are no such doctors; a doctor is perhaps a family physician, or he is a surgeon, and if he is an internist he is not just that, he is an internist in heart disease or he is a surgeon of the brain, or whatever, and then there is more and more specialization.

In a medical school it would seem quite unwise to me to take the Department of Internal Medicine and the Department of Surgery and try to put it all together. There obviously has to be correlation at a top level, so that undergraduate students are taught all that they need to be taught, and that there is not duplication. However, to lump all these together would not allow each to grow and develop as it needs to grow. Each division and each department in a medical school has its own particular interests, its own particular skills and its own particular problems to investigate, and I think they require a degree of autonomy. In some medical schools when they try to group everything together it looks much neater on a page of paper, but it does not really work quite so well, just because people are people and they feel too constricted. I think that this is a reasonable analogy.

The Medical Research Council has an entirely different role to play, and it has played a different role than the Department of National Health and Welfare, and I have had experience now with both. So, I think it would be unwise just to lump them together for the sake of looking a little different or seeming to work better.

The Medical Research Council, as I see it, has shown excellent stewardship of their funds that have been entrusted to it, and really have done, I think, the best possible job with the funds. I think there is much more to be done and much more money is necessary in order to do this. Medical education in itself is becoming more complex, but sometimes through good research many of the complex conditions that had to be talked about and had to be treated in years gone by are now prevented.

I would like to emphasize what Dr. LeClair said about the medical schools. If we do not have research

going on in our medical schools, then we are going to have trade schools rather than academic institutions.

Senator McGrand: Dr. Sullivan mentioned that he was going to ask a question about transplants.

Senator Sullivan: That will come a little later.

Senator McGrand: I had intended to wait until you had asked that.

Senator Sullivan: Because I thought that all Senators here would be interested in liver transplants.

Senator Leonard: And other parts too, Joe!

Senator Thompson: Brain transplants!

Senator McGrand: I may be asking Dr. Brown to repeat something he has already said. He mentioned social goals and larger goals. We may disagree on what these goals should be, but I should like to have you just say a few words on what you meant by obtaining social goals—if you recall what you said earlier in your remarks.

Dr. Brown: Yes. Mr. Chairman, I think in the setting in which those words appear, what was in mind was this general idea. We do not as a country—no country does—want science to exist simply for science's sake, with the single exception of the fostering of science as a cultural activity as one supports work in the fine arts. For the rest, for the much bigger part of science activity, we look to it because of what we think it can do for us. It would seem then that we would support it, with this most important exception that I made, because of what we expect from it, what we get from it. We evaluate it in these terms and what we get from it is related to what we want overall and, in this sense then, to our initial goals which are social and personal, communal and national. I think that was the setting in which that was written.

Senator McGrand: That would also include what you mentioned, larger goals; that would be the same thing?

Dr. Brown: Yes.

Senator McGrand: Would you list, if you can, the leading research laboratories in Canada in order of their importance? Could you do that, or is that a fair question? Could you list them in order of their importance as to the amount of work accomplished, fitting this into the wide picture that you have talked about?

Dr. Brown: Yes. Mr. Chairman, there are many reasons I might like to duck that question, and some of them are good!

Senator McGrand: That is all right. I said if you could.

The Chairman: You might get into trouble next year when we come to the allocation of funds.

Dr. Brown: Some of them are good. It is hard to isolate a laboratory in this sense. What is a laboratory? Is it the whole university complex, or is it someone's individual lab.? The second thing one comes up against is the balancing of absolutely first-class work in one field against first-class work in another field, and then you begin to say which field is better. Well, you have moved straight away from which laboratory is better, and it is for those good reasons, not forgetting some of the other reasons too, that it is difficult to go much farther with that question.

Dr. Salter: Would you say, Dr. Brown, that in a sense it is rather like comparing a violinist with a pianist or a tuba player: you may have three excellent men doing three different things. Really the important aspect of research, I suppose, is ideas, and ideas come from the minds of men, and the value of research projects are related to individuals rather than to institutions. It may be in some institutions, just because they are larger or because the administrative head has a little more foresight in gathering more of these people around him that they seem to be at one time ahead of another group. I think it is fair to say it still depends on men.

Senator Thompson: Would you go to this extent, doctor, to say that there are areas of research centres that perhaps are weaker than other research centres.

Dr. Brown: Well Mr. Chairman, in the sense of volume, of course.

Senator Thompson: The calibre of work, for instance.

Dr. Brown: The calibre of work is rising steadily, and there is a large amount of what is good. The total volume is too small. Naturally, there is some disparity from one region to another too in the distribution of what does occur.

Senator Thompson: I noticed you said in your brief that in some cases to give financial assistance might be to increase mediocrity. It is not the only answer.

Dr. Brown: No, money is not the only answer to this. Most of the problems would be difficult to solve without money, but money will not solve all of them.

Senator McGrand: That was only half the question I asked you, because I was thinking of the duplication of research on a certain project that goes on in one institution, and then perhaps that is being duplicated or will be duplicated by the research that goes on in

the laboratories conducted by the large drug companies. That is what I was thinking of, the co-ordination of this research. There must be co-ordination between the drug companies and what goes on in our university laboratories, must there not?

Dr. Brown: Not between the Canadian drug industry and the universities, save through the medium of the literature.

Senator McGrand: Well then, you have answered the question. I have another one or two.

Senator Leonard: Could we get that answer clear? You said there was no co-ordination between the drug industry and the research work done in the universities except through whatever literature might pass?

Dr. Brown: And communication. This is a terribly important qualification. If the researchers in drug companies are good, they know what is going on in various places, otherwise they would not be good, and they are not going to duplicate the work if it has already been done, unless they have some doubt about it and want to confirm it. Similarly, the university worker whose career depends to an extent on doing good research and making new contributions is going to be jolly careful not to do what has already been done. So that there are these very strong pressures to remain novel in one's work. They are very strong; they are very important. The avoidance of duplication is something that one wants to press on with. What one has to be careful of, though, in the management of science is to be sure that one does not prevent people from seeking the solution to things and the development of new ideas, and to say to too large an extent: "Now look, we have enough people thinking about this particular problem, you are not to think about it; you are to go off and think about something else." This is a very dangerous area.

The Chairman: Just a brief question: we are told that as a result of the legislation which is before Parliament now regarding the drug industry, some research labs already existing in Canada are closing. Are you aware of this?

Dr. Brown: The details of that situation I am not aware of, no; nor the labs which it is proposed to close.

Senator McGrand: What I was thinking of is this: McKenna, Ayerst put out Premarin, don't they? They have done a lot of work on Premarin, and it has not been duplicated. The synthetics are supposed perhaps not to be as potent as Premarin. These are questions I am thinking about.

Senator Thompson: Could I just follow the doctor on that question? I was interested in that duplication question, and I notice, sir, in your MRC report. . .

Senator Sullivan: Page 385.

Senator Thompson: No, it is 355. This is the MRC Report. I notice you refer to the fact that there are fourteen universities—I am a complete layman in this area—and I note that the last type of instrumentation is telemetry, and I think there are, as I understand it, five universities doing research in telemetry. Am I right in that?

Dr. Brown: Yes, Senator Thompson.

Senator Thompson: Are they each taking individual areas, or is telemetry basic to research? I mean, why are five of them doing work on this?

Dr. Brown: Yes. Mr. Chairman, the explanation lies in the fact that telemetry is a technique which can be applied to work in many fields and many areas, and there is not duplication of effort here. One group, for instance, will be interested in the telemetry of the electro-cardiogram, so that you can have people running around a racetrack and sit down where you can read their electro-cardiograms; and another group will be applied to the head, and so on and so forth. This is the explanation for what may seem at first to be duplication, but it is really multiple attacks rather than duplication.

Dr. Salter: Mr. Chairman, commenting about instrumentation in general, some of these things seem very sophisticated to you, I am sure, but in a sense they are analogous, say, to the microscope of fifty years ago. You wouldn't say it was duplication that research workers across Canada were using microscopes. These are research tools through which information can be gained. They are research methods rather than concepts.

Senator Thompson: Thank you.

Senator McGrand: Over the last thirty years there has been a great deal of emphasis placed on this condition known as stress, and tremendous work has been done on it, and articles written on it. But, after all these years, is there any drug that has been produced, which is available to patients, that prevents them from developing this ageing process that is due to stress? Is there any drug on the market, available to patients, to counteract it?

Dr. Brown: Mr. Chairman, there is no single drug that will prevent the process of ageing.

Senator McGrand: Or combination of drugs. We will put it this way: I will say drug or combination of drugs?

Dr. Brown: Or combination of drugs to stave off the aging process?

Senator McGrand: Yes.

Dr. Brown: I am afraid the answer this morning remains no.

Dr. Salter: And perhaps it will remain so.

Senator McGrand: Well now, I do not intend to steal Dr. Sullivan's thunder or anything like that, but I just want to ask you this question about transplants. There is a great deal of importance attached now to organ transplants, especially heart transplants, and I am wondering if money is made available: does this project get any preference in the allocation of grants? And are we any closer today than we were twenty years ago to knowing the part animal fats and vegetable fats play in the development of arterial disease? Are we any closer to it?

Dr. Brown: Mr. Chairman, to take the two questions perhaps in reverse order: I think yes, we are very much closer, and the long-term value of high animal fat diets, of course, is very much in doubt, while its bad effects are fairly clear.

With respect to the question concerning transplants, the Medical Research Council has given special attention to this, and the antilymphocyte serum project is really part of this special attention. As you will have read, this project has to do with the determination of the efficacy of this serum, first of all in renal transplants, but it will be applicable to all transplants. It is the renal transplant situation which is being taken as the test situation. Council has given special attention to it, and, within the limits of its budget, has given it the support that it can.

Senator McGrand: You say you think we are definitely closer to the part played by animal fats and vegetable fats in the bringing on of arterial disease. Are you close enough to a decision that you could say animal fats are bad and should be removed from the diet? What I am thinking about is that we have millions of people with arterial disease, and we have only relatively few, perhaps one in 50,000, who have a heart that needs to be overhauled, physically or mechanically overhauled and replaced. I am thinking of the importance of prevention of this type of heart that has to be replaced, by a good, sound practice of dieting and so on that would keep this condition from developing eventually.

Dr. Brown: Mr. Chairman, it is the excess of animal fats which gets people into trouble. Moderate amounts, small amounts, do not create the problem. It is excess amounts in the circumstances, and the circumstances vary from individual to individual. Obviously some can tolerate them better than others, and those with the same inherent capacity for this tolerance of these fats can modify their tolerance by sitting still all day, for example, as opposed to running up

and down stairs all day. So that it is a very complicated situation. When one is concerned about the role of animal fats in the development of arterio-sclerosis, it is always the role of excess animal fats, not a condemnation as a dietary source of the whole list.

Senator McGrand: But there is a relatively small number of people in the world who are aware of it today.

Dr. Salter: If it would help in answering this question, you could compare this to alcohol. Alcohol is a food; really it is the excess ingestion of alcohol that causes the problem, and it causes a problem in some persons more than others because of genetic background and so on, but just because a small percentage of the population has a problem with alcohol does not mean that you would be likely to succeed if you suggested that alcohol not be consumed at all.

Senator Sullivan: Hear, hear! That is a real good answer.

Now, on page 57, Dr. Brown, you describe pretty well what has been done by the Medical Research Council in conjunction with the Connaught Medical Research Laboratories and the Institute of Microbiology and Hygiene in Montreal on this factor of transplants. I am quite sure Dr. Salter might transplant a hip-joint one of these days. I am not sure, but he may be after it, the same as we are attempting to transplant a middle ear apparatus. Do you want to speak on that?

Dr. Salter: Well, the actual surgical exercise of transplantation of tissue or of an entire organ is not the most difficult aspect of transplantation, as you all know. The real problem is that apart from identical twins in this world we are all completely different one from another, and tissue from one individual is not accepted at least permanently by the other individual. So that the real problem to investigate here is not the technical aspects of transplanting a piece of tissue or an entire organ, but rather studying the ways in which you can first of all find matches, that is find two individuals who are most compatible with the least amount of tendency towards rejection; and, secondly, ways in which one can not only treat the rejection phenomenon, but hopefully to prevent it from occurring, and I think that the antilymphocyte serum project that has been carried out by MRC in this country is a superb example of the co-ordination of the efforts of many people across the country, initiated and fostered by the MRC, and I do not really know of any other research organization in Canada that could have quite accomplished that. One of the reasons is that the people who are most actively engaged in the MRC—and I am speaking now not only of Council members but also all individuals who are on Grants Committees and who are advisers and so on,—these people repre-

sent the top scientists of the country, and they have a common goal, that is to improve the standard of research work and thereby to improve patient care. I think that the MRC has done this superbly, and it has been an example of co-ordination of efforts across the whole country—co-ordination rather than duplication.

The Chairman: Following those remarks, doctor, can we say that in Canada we are trying to specialize in certain fields of research rather than others, or do we try to cover the whole field?

Dr. Salter: I think it is not possible for any given university, or indeed any given country, to be equally expert in absolutely all aspects of medical research. It is rather comparable I think again, to a medical school, say within a given department, where you have strength that is related to individuals, and if a man is particularly strong in one facet of his work, then that is emphasized. It is important, I think, to appreciate that if you emphasize the strength that a man has rather than to try to make him equal in all things, then the most good will come from it. At present in Canada there are many individuals who are well qualified and who are skilled in this particular field, and in that sense there is emphasis at this time in relation to this program. If, on the other hand, five years from now it were found that there was some other aspect of medical care or a medical problem that was of greater importance, or for which we had people who had more skill, then the emphasis might change. I think it is fair to say that in any country from time to time there will be more emphasis on certain things than on others; it is not static. But I wouldn't think that it would be wise to say: Well, we in Canada are going to put all of our efforts into heart disease, for example, rather than other things. We should try to cut our suit according to the cloth that we have, the cloth being the human beings and the ideas and the available facilities.

The Chairman: It has been suggested that Canada could become a world leader in a few short years, and if we were to concentrate, for instance, on virus research, do we try to develop? Does the Council have its own list of priorities in the field of research?

Dr. Brown: No, the Council does not direct research in that sense, Mr. Chairman; to say, for example, for the next five years the big thing is going to be virology and applications in this field will get preferential treatment. No, it does not do that.

The Chairman: So you are really passive. You get these applications and then you judge them on their merits, irrespective to the priorities that you could have in your own mind, or in the minds of the members of the Council?

Dr. Brown: Not quite. It is true, as you said, that we receive these applications and give support to those

that we can which are good. But in addition there is probing and seeking out, and there is fostering of work in this field or that field. Your earlier question had to do with an over-riding priority: no, this does not exist. But to foster work in certain fields for a period of time, in addition to considering on their own merits the bulk of the applications, we do this yes; so that it is a mixture.

Dr. Salter: Would you say, Dr. Brown, that one priority that we consider fairly frequently is the new investigator and the new medical school, and that we have perhaps particular sympathy toward an application from someone who has committed his life to be an academic surgeon or an academic physician as opposed to a private practitioner. We recognize that the most difficult grant to be awarded in a man's career is the first grant, because he is not known and he must prove himself. I think in that sense we would have a priority which is in favour of fostering new men and getting new men started in an academic institution, but, of course, once started, they must prove themselves.

Senator Leonard: Because you never know where a Banting will turn up, do you?

Dr. Salter: That is correct.

Dr. Brown: No, characterizing it in this way there are priorities, subject areas, but not over-riding priorities.

Dr. LeClair: Mr. Chairman, I just had one remark to add on this over-riding priority: if there were such a case as let us say over-riding priority to virology research, then medical education would be impossible because that would mean that we could not get, for example, biochemists, and biochemists are essential to produce doctors. So in that sense it would be very dangerous to have an over-riding priority in terms of research.

The Chairman: I was not referring to over-riding priorities, but surely we must have a general program where we either take the risk of developing a new man, as you have just said, doctor, or of supporting and assisting excellence, that is for sure, as more or less the foundation of your general program of research. I was wondering whether on top of that the Council was trying to develop research in certain sectors rather than in others?

Dr. Brown: Yes.

The Chairman: Because we all know, for instance, that there is such a thing as an international community of research in the field of medicine as in other fields, so that we might perhaps in Canada find areas where we could do a better job than certain

other countries and try to specialize and put some emphasis on these fields.

Dr. Brown: This is done. The extent to which the Council has been able to do it is very distinctly limited by its funds, because when it has provided support by the first method which you have mentioned, on a broad basis, on a basis of merit . . .

The Chairman: You have nothing left.

Dr. Brown: . . . there is not all that left with which to manoeuvre. But there is the second sort of thing that you mentioned as well, and this is a matter of building on strength in most cases. The Medical Research Council's Group in neuro-physiology at the University of Montreal is an example of this. There was strength here, men with international reputations, and arrangements were made for them in conjunction with the University so that they can devote, over a minimum period of five years, essentially their full time to the prosecution of these things at which they are particularly good, and it is a red-hot field. This is the sort of thing we would like to be able to do more of, but when we have finished this broad job which is, to quite an extent, concerned with educational support and the other factors, we haven't that much left over.

The Chairman: Senator Thompson?

Senator Thompson: Mr. Chairman, I would just like to underscore again the point that seems to be coming up, that there is a great limit on finances for your work. My impression in reading the brief was that perhaps you stated this rather quietly. I refer to page 29, and I think that this is one of the only mentions of that, when you said:

Another major problem is the lack of funds to meet valid needs in the extramural program.

I have a sense that that is almost a British understatement of what your needs are. But, if I could, I am interested in the relationship of the Health Resources Fund. I suppose on the one hand you can go out and get scientists, research men, but if you do not have equipment and space co-ordinated with the scientist coming to the job, it is a frustration for him, and really is an empty exercise. I would like to ask who decides on the health resources financing, and is there a complete co-ordination between the HRF and MRC?

Dr. Brown: Yes, I see, Mr. Chairman. As you will be aware, the expenditures under the Health Resources Fund are made as a result of decision first of all at the Provincial level, and then at the Federal level; so that there must be this co-ordination of decision. The initiative comes at the Provincial level, or, beyond that, within the universities, and then is

processed at the Provincial level. So that this is the decision-making process there.

Then at the Federal level there is the limit on the expenditures per year that we all know about.

As to co-ordination, a great deal of effort is spent on this in various ways. Regulations have been drawn up and are followed so that there isn't a double-funding of the same thing, and so that it is as clear as we can make it with the printed word what requests should come up through the Health Resources Fund channels, and what requests should come directly from the universities to the Medical Research Council. Also, at the level of the consideration of the detail of individual applications, a great deal of staffwork is done. Then a further point: the relevance of some proposed items of equipment to be purchased under the Fund may be a matter for discussion between the officials of the Department of National Health and Welfare and ourselves. These are the ways in which it is tied together.

Senator Thompson: Are you satisfied, Dr. Brown, that it is meshing well? Are there scientists across Canada who are stopping recruiting researchers because of the fact that space and equipment are not co-ordinated properly, they are not able to get it?

Dr. Brown: There are certainly scientists who are in difficulties because of space. There are universities that are in difficulties because they do not have space with which to attract good scientists. The Health Resources Fund is the federal Government's contribution, part of it, to this problem, but these other steps are a necessary part of the process. There are requirements at the provincial level. The university must convince its own provincial government that this should be supported by the provincial government, and hence in part through the Health Resources Fund. There are some anomalies that none of us foresaw at the beginning in the way of eligibility for support, and non-eligibility and so on. Some of these have been worked out, but I think that we must just be a little careful to recognize that there are two things: there are the space difficulties that many universities and departments have, and there is the Health Resources Fund, and you cannot solve all these space difficulties through Federal action in connection with the Health Resources Fund, because there is a combined decision here, provincial and federal.

Senator Thompson: I noted—I am not sure whether it is in your brief or whether I heard this—that eighteen months after the contract MRC looks after the funding. Am I correct in that?

Dr. Brown: Mr. Chairman, when the initial regulations were first set up by the Department of National Health and Welfare there was wide consultation

taken by them about this. There was provision for access by universities and provinces to the Health Resources Fund for a period which began with the beginning of construction—the signing of the general contract actually is the technical date—and a date eighteen months after completion of the building. This meant that during that time they could go to what was thought in the beginning to be this tremendous pool of money for equipment. Now, during that time it would follow that they were not eligible for Medical Research Council support, because, you see, through one channel the Federal contribution is 50 per cent, and through the other channel it is 100 per cent, and the two purposes are slightly different. So there is this exclusion from the 100 per cent support for major equipment during the period that I have mentioned, in which as far as the federal Government is concerned there is access to the Health Resources Fund; but the Provincial Government may or may not want that particularly.

Senator Thompson: Was it your decision to have that eighteen months, or was that imposed on you?

Dr. Brown: No, that decision was taken under the Health Resources Fund Act, and that is Health and Welfare.

Senator Thompson: Do you agree with this? I mean, are you happy about that eighteen months clause?

Dr. Brown: Not in its full implications. I do not think any of us are. In fact we have had many discussions about this with many people, Health and Welfare people and so on. It needs rather more complicated policies than would seem to be revealed by that simple regulation. There is some detail, some of which has been worked out, but some detail that needs to be worked out so that it makes sense across the board.

[Translation]

Senator Bourget: Dr. LeClair, is a part of your budget devoted to engineering, either mechanical or electrical engineering? Do the engineers work with the doctors and form part of the same schools, even though they belong to the faculty of mechanical engineering or electrical engineering? Do you have these figures?

Dr. LeClair: Yes, if you look on page 16 of the brief.

The Chairman: If you will allow me, I believe Senator Bourget means within the university.

Senator Bourget: Yes, within the university, among the various faculties.

Dr. LeClair: To give you a simple example, one of the committees is called "Bio-Engineering"; it has been formed to meet the demands we get from engineers who work on health problems in co-operation with scientists in the field of health. This has become so important that a committee has been set up to consider the applications for grants we get from "Engineering".

The Chairman: But, inside a university, how is this co-operation effected?

Senator Bourget: Do they work together?

Dr. LeClair: Yes, what happens . . .

Senator Bourget: Do they work together or in separate faculties, the mechanical engineering or electrical engineering branch?

Dr. LeClair: No. For example, most of the faculties of medicine have full-time engineers on their staff who undertake research in conjunction with other research workers. The majority of our faculties of medicine have such people on their staff; this is becoming the case more and more.

Senator Bourget: Now, a little while ago we were speaking of provincial contributions. What is the contribution of the provinces, let us say the Province of Quebec. What financial assistance does it devote to research? Are you familiar with these figures?

Dr. LeClair: Well, as far as Quebec is concerned, there are two methods: the first . . . there are three methods in fact. The first is what research costs the university itself and what is called research overhead which is presently paid by the university, that is, by the province, the provincial government, the Department of Education.

Secondly, some funds are provided by the province through the national health funds, the Health Resources Fund.

And, thirdly, in Quebec at least as in some other provinces, there is a Medical Research Council. The Medical Research Council of Quebec itself gives grants in areas complementary to those for which the Medical Research Council gives grants. The two fields are not identical. There is no competition between the two.

The Chairman: What would be the amount for, let us say, the Province of Quebec?

Dr. LeClair: I believe that, in the case of Quebec this year, the amount is \$600,000, the total amount given by the Medical Research Council of Quebec. For the other provinces, I do not know. Dr. Brown is more familiar than I with what is happening in the

other provinces. But this is supplementary; there is no duplication of effort. In its expenditures, the Medical Research Council has what is called an establishment fund for young research workers; the research worker, established for one year, for one year only, has access to a grant which may vary from \$10,000 to \$20,000 to assist him in purchasing equipment before he has made a name for himself through a little research after which he may apply to the Medical Council.

Senator Bourget: What percentage of medical school graduates take up research?

Dr. LeClair: This varies from one university to the next as it varies across the country. Fifteen years ago, the figure was one, two percent; now I would say that it is perhaps twenty-five percent. But this percentage does not indicate the number who finally remain in research. There is a considerable percentage of people who begin in this field only to abandon it. Once again we must realize that for a doctor, whether a general practitioner or specialist, one or two years of training in research has become almost essential now. Learning what research entails is as much a part of his normal training as learning to prescribe medicines. When a representative of a pharmaceutical company comes to see a doctor and offers him a new product, it is very important that the doctor be capable of evaluating the research behind the new product to judge whether it is really something good.

Senator Bourget: Thank you, doctor.

[Text]

The Chairman: How many of these provincial Medical Research Councils do exist in Canada?

Dr. Brown: Of Medical Research Councils there are only two in the formal sense, and Ontario's is not actually called a Council: It is the Research Committee of the Council for Health. These are small operations, and, as Dr. LeClair has said, where they exist we desire to make them complementary, to do what needs to be done in the local situation, which is not easy to do if it has to be done through the Medical Research Council.

The Chairman: Senator Thompson?

Senator Thompson: Dr. Brown, I had wondered if there is any relation here with the debate going on in the United States, as I understand there is, concerning allocation of funds for medical research, public health and so on—if there is any relation with this? I think coming through very loud and clear is the point that you want a corporate body removed from the Department of Health. You would under-

stand this far better than I, but I am looking at this 1963 "Review of National Science Policy" in the United States, and it says:

In 1963, a Congressional Subcommittee of the House Committee on Government Operations opened an inquiry into the administration of the appropriations assigned to NIH—

which is the National Institutes of Health—

and questioned the efficiency of this agency. Following the stir raised by this approach, and on the instructions of the President, a Committee of Scientists launched a new inquiry into NIH activities.

Notwithstanding some reservations, apparently the report was favourable to the institutes. But the basis of this apparently is that the present trend nevertheless seems to be alarming the scientific world, which is afraid that fundamental research will be the victim of adjustments. Some of the NIH directorate would like to make them into an autonomous agency and HEW in its public health service would then be directly responsible for implementing medical and social policies. Would you care to comment on that? They refer to the fact that there is a great debate going on: as I understand, for the Great Society they felt that they wanted to be sure that research was going to be implemented for the benefit of people through public health policies. Do you see a relationship to the situation in Canada today?

Dr. Brown: Yes, I do, very much, Mr. Chairman. I think we must, however, avoid too much lumping here. When one speaks of the support of research, then I think to be completely meaningful one must explain right away what sort of research one is talking about. Is it research in the universities which is to a large extent basic—research in the universities which you support to quite an extent because it is in the universities and it has all the implications that scientific work of high quality in that setting has for all of us; or is it, on the other hand, research which is not basic in that sense; it may have a basic component, but it is not basic in that sense, it is applied research. It is directly oriented to a mission and it is related to a problem which we want to have solved as quickly as possible, and it is a problem which has a scientific component which is amenable to solution. I think that the methods of support that you use in the two areas, if they are to work well, have to be quite different, and I think that the decisions about the degree of support have to be taken in different settings as a result of these two quite different situations.

This was why I suggested to the chairman earlier in the morning that really there is no contradiction between the view of the Medical Research Council that it would work best and most efficiently as a

corporate agency, and the problems—and the best solution of problems—that have to do with total Federal effort, total national effort, in the health care area as a whole. One is related to the other. But you do not, for example, try to administer the spending of money or the allotment of money to university research with the same administrative machinery or the same people with which you supervise the health of immigrants. These are two different operations requiring different approaches, different techniques and different methods.

Senator Thompson: But when you get to the public,—I think all three doctors have referred to the patient—Canada today does not stand very high in its health care when you look at infant mortality, for example, in world indices. I think we are lower than Japan and certain other countries.

Senator McGrand: We are thirteenth.

Senator Thompson: Thirteenth, I think yes. I realize that we have a native population and we have problems with respect to Indians and Eskimos, but there are other countries such as Finland who have had this and tackled it well. With the actual translation of the advances in science to the patient I wonder as to your concern about doctors and the training of doctors in medical schools. I have another quote here. It is from "The Coming Revolution in Medicine." I am sure you are acquainted with this, but do you as doctors need assistance by way of computer facilities? Does this interest you?

Dr. Brown: It did interest us very much, because we are interested in the application of the results of research, and "the coming revolution in medicine" has to do really with a managerial problem, doesn't it, not a scientific problem; it is a managerial problem, and though it does come under the umbrella of the same social goal, it has to be settled by different means.

Senator Thompson: But who is responsible for that managerial problem?

Senator McGrand: Sure, that is the question.

Dr. Leclair: Mr. Chairman, I think you are quite right. Mr. Rutstein in his book "The Coming Revolution in Medicine" shows how in the United States as more money was spent for research the health of the people went down: the two curves almost crossed. But this, I do not think, is the failure or would be the failure of the Medical Research Council.

The Chairman: It is the failure of the patient!

Dr. LeClair: In a sense it is the failure of the schools of medicine themselves. I think it is up to

them to take what we can have from science, namely the help of the Medical Research Council, and apply this to the public. Our school, and more and more schools, especially the new ones because it is easier for them to do this, are dedicated to this very aspect. This is our characteristic, to be able to bring to the people the benefit of what we have in, almost in some cases, ivory towers. For example, Dr. Macleod is working a lot on this. Recently, in a symposium in Atlanta where most medical schools got together, the one over-riding conclusion of that conference is that we have now to be aware—in other words, almost the magic word now is social awareness on the part of medical schools. This is why, for example, in our own school we have three divisions; one of these is social medicine, and to us this is as important as basic science or clinical medicine, to be able to give to the population what we really should have been giving them many years ago. So I think if there is a failure—and I think there is, personally—it is at the level of the medical school, not so much at the level of the granting agencies such as the Medical Research Council.

Senator Thompson: Isn't there a science in the management of medicine, and wouldn't this be one of your functions, to be looking at people like Rutstein and others who have been doing a study of this, or do you not think so?

Dr. Brown: I do not know whether one would call it a science but yes, there are many managerial studies. Actually, the responsibility for operations research has been delegated to the Department of National Health and Welfare, and they have a very real interest in this and are prosecuting it; and there has, as you know, been the setting up of the joint federal-provincial facilitating committee in this respect.

The Chairman: You were saying a moment ago that the NRC is devoting about half a million dollars a year to intramural medical research in the field. Do they seek your advice as a Council in developing that research program?

Dr. Brown: No sir.

The Chairman: Do you know what is going on there?

Dr. Brown: Yes. Yes, we know.

The Chairman: But you have no say in the selection of programs, or anything of that sort?

Dr. Brown: No sir.

Senator Bourget: What kind of research are they doing there?

Dr. Brown: There are many kinds, Mr. Chairman. There is a good deal of research in the division of bio-sciences that is relative to health, in radio biology, in the division of mechanical engineering, in the division of radio and electrical engineering, and in the division of applied physics. There is quite a variety of projects.

Senator Bourget: It would be mostly in the engineering field, to help medicine?

Dr. Brown: The chemistry and microbiology in the division of bio-sciences is also sizeable and probably balances the engineering.

The Chairman: I think that everyone in Canada recognizes that NRC, through its intramural research activities, has made a great contribution to research in Canada, especially in the field of the physical sciences. Would you think, assuming that the money could be found, that such a similar institution would be desirable for health research or medical research?

Dr. Brown: Not a similar institution, Mr. Chairman, and this is not to be derogatory in any way of the National Research Council labs., but the needs are different and the history is different. The Council does not feel, and it has given its attention to the question several times, that a large national medical research institute is applicable to the Canadian scene, or is the best way to spend money on medical research in Canada at the moment. It is, however, interested in the possibility of smaller institutes—in the plural—situated perhaps at different places in the country, invariably in conjunction with a university.

The Chairman: You are speaking now of Government institutes?

Dr. Brown: Government institutes which would have very definite and prescribed goals, and while they would be in a university setting, they would be to quite an extent at the same time mission-oriented. So that there is, in our thinking about it, the idea of regionalization, the idea of keeping the researchers in close conjugation with the universities and research situations and all this sort of thing, and the idea of a definite, not too narrow but quite a definite, mission for these. It does not include the idea of a medical research institute which is free to roam across the whole field of medical research as the run of the cards dictates.

The Chairman: But these institutes might fulfil a kind of residual role.

Dr. Brown: They might be taken to serve for the time required definite and recognized—widely recognized—national needs. One of these the Council has explored to quite an extent, and it is concerned with:

research in drug metabolism and intoxicity, that is the research and science back-up of drug testing. A great deal of research in this field has been done by the people in the Food & Drug Directorate, but they are limited in the capacity that they can devote to the research by their service responsibilities. Actually the discussions were initiated with the help of some of the staff of the Food & Drug Directorate. There is no contradiction here, there is no overlapping; but here is a field in which a great deal of additional information is needed, and in which there is the possibility of making real advances in technology by the application of recent principles and so on. Now, this sort of small institute, five to ten professionals and their supporting staff, might exist in the number of two or three, and be in two or three separate geographical situations. This is the line along which our ideas go when we think of what we call intramural labs., but they would be extramural in the sense that they would not be in Ottawa, and by that I mean in the University of Ottawa.

Senator Sullivan: To that you added computer facilities, didn't you?

Dr. Brown: The support of computer purchase, computer renting and computer services has got to be a very complicated question, and we are having a look at it to see how best we can use funds to serve our people.

The Chairman: But if you were to go into this computer business, don't you think...

Dr. Brown: No.

The Chairman: Well, I suppose, it might be very useful at some stage. Then we might need a national centre for this, or a kind of central data bank.

Dr. Brown: No, we are not exploring the possibility of MRC computer institutes. We are exploring rather the way in which we might best spend our money to meet the computer needs of our researchers. To a certain extent this will, for example, be the purchase of little computers, single-use computers, as opposed to the provision of funds to give a group of researchers access to a large computer. This is the sort of area that we are working in.

The Chairman: And they would have access to the services in the United States, for instance?

Dr. Brown: In the information retrieval situation, yes, through the National Science Library.

Senator Thompson: Doctor, on this I am just looking at "Business Week"—I am afraid as a layman I just pick up things—but it is suggested that the computer and the science of medicine would seem to make a

perfect match; for computers the mass of broad data that flows out of medical research laboratories is made-to-order nourishment, and it goes on to describe this. Who would look into this in Canada, as making a more efficient method of getting research knowledge out across to doctors? Who is responsible for this?

Dr. Brown: Could I put your question in this way: Who is responsible for the continuing education of the profession?

Senator Thompson: No, I put it this way: who is responsible, or is there anyone responsible for seeing that the research knowledge is in the most efficient way brought across to the private practitioner?

Dr. Brown: There are many people at this, as you will be aware: governments, different levels of government, and at the municipal level; universities are growing, and there are some most important educational programmes, including 8.30 Saturday mornings now in the City of Ottawa, by the University of Ottawa. The drug companies have made a contribution here too, because they have been a means of spreading information. The voluntary agencies: the National Cancer Institute, and the Canadian Cancer Society and the Canadian Arthritis and Rheumatism Society, the Canadian Heart Foundation. All of them do this too, so it is a job that is being done by many people, and there has also been a change in the material which the individual doctor has when he is sitting in his own home and has some time to put in at it at his own choice. The number of review journals has increased, and there is now in Canada a medical newspaper too, put out in newspaper format; this is Medical News. So the problem that you are after is being met at the present time in these various ways.

Senator Bourget: But there is no centre of distribution of that calibre of information?

Dr. Brown: Not one centre.

Senator Bourget: Don't you think there should be one?

Dr. Brown: There should be at least one strong one. I would doubt whether there should be one to the exclusion of others.

Senator Kinnear: Mr. Chairman, I would like to ask a question. I want to know what research now is going on regarding retardation in children, and if you are having any success in curing it, or improving their situation; and also for crippled children. Very small children, I imagine, could be helped greatly if they have crippled arms, crippled legs or something like that, with the new advances in bone transplants and so on. Also there are the mental patients, the mental health cases; what research has there been and how

effective is it at the present time in relieving hospital space and getting these people back into circulation? Could you deal with those three questions?

Dr. Brown: Yes. If we might take the one concerning mental retardation first of all, there is a great deal of work going on in this field in various places, and advances are being made, and in very practical ways. For instance, there is much wider use now being made of a very simple urine test to be used a few days after birth looking for one of the common causes of mental retardation, which is preventable, or can be treated if appropriate steps are taken during childhood. So both in the accumulation of knowledge and in its application I think there is real advance being made here; the federal Government provides specially ear-marked funds for this purpose through the Department of National Health and Welfare, not through ourselves. We are prepared to receive applications for support in this field and consider them on their merits.

In the general field of mental health, I think perhaps the change in hospital patterns in the last fifteen years provides the answer to your question. There has been this change: there has been an earlier return to the community, there has been increased emphasis on the treatment of minor but still important mental illness, with the result that the total psychiatric effort is undoubtedly much more effective than it was before in terms of keeping people at work, and in getting them back to work quicker when they have had to leave.

The part of the question that has to do with crippled children I will, of course, turn over to Dr. Salter, because this is very much his business.

Dr. Salter: Mr. Chairman, if I may just say something additional about mental retardation, because I think it is pertinent to what we were discussing earlier. It has to do with the prevention of the particular type of mental retardation which is associated with disturbed metabolism, phenylketonuria, usually referred to as "PKU". The story I wish to tell, I think, is very pertinent. The head of our Department of Biochemistry at the Hospital for Sick Children retired at the age of 70—he was actually kept on for a long time—but almost as a hobby he had always been interested in pure basic science and pure basic research; he continued to study, and he worked very hard, and he developed a test for this particular substance in the urine, not realizing at all that this would in fact be of some practical application for the prevention of any disorder in patients. However, having done this, shortly afterwards it was discovered somewhere else that this particular substance was of great importance. It was important to detect it very early, shortly after birth indeed, so that something could be done to prevent the effects of the disturbance on the brain. So this is an example of basic research that was done for the sake of research and which was terribly important

to support, and which has an application today even though the application was not foreseen.

The other thing about prevention of mental retardation is that through research that has been done largely in this country by Dr. Chown in Winnipeg, concerning incompatibilities of one particular factor in the blood, the Rh factor, studies along these lines have led to the prevention of one of the causes of cerebral palsy in children, which is often associated with mental retardation. So from a research point of view, really the emphasis has been on trying to prevent the original cause of mental retardation. We have no way at the moment of preventing mental retardation in a child whose parents are both somewhat mentally retarded, because Mendel was right and genetics does come through. But there is a good deal of research work going on in the prevention of this, and a good deal of it is supported by the Medical Research Council. The actual logistics of the care of a large number of mentally retarded children, as Dr. Brown has already pointed out is under different auspices.

In relation to crippled children, I think it is important to get away from the old concept of a crippled child as a child, for example, that had polio and who was crippled in the sense that he had a weak leg or a short leg or something of this sort. Crippling now is considered by the various associations for crippled children in Canada on a much broader basis. It is considered really more as a handicap. A child who has congenital heart disease has a physical handicap in that he cannot run and play and do the things the other children can do. It is not obvious perhaps on the outside that he is crippled, but he is handicapped. The same is true if he has chronic lung disease, or if he has diabetes. So that the concept of crippling has changed a good deal, and I think it has been a very good thing.

The Ontario Society for Crippled Children, which gets a lot of money from the public, uses some of this money for research and does in fact support a good deal of research in Ontario related to the problems that I have mentioned, the problems relating to handicaps in childhood. That is very much clinically applied research, and some of it is epidemiological research, some of it is studying the incidence of disease in various areas; some of it is related to animal experimental work in trying to develop a better form of treatment related to children's problems. So the Ontario Society for Crippled Children and some of the other societies for crippled children in Canada are doing something, but they have, of course, limited funds.

I think that the next thing I am going to say is important in relation to the role of MRC, because, as Government takes more and more initiative in paying for everything, the public feels less and less inclined to give to charitable institutions. The public twenty years ago would give a great deal of money for the care of crippled children, and indeed for research related to crippled children, but those same individuals now

would say: "But this is all done through Government, so we don't need to do this any more; it comes out of our taxes." This is happening in Great Britain, it is happening in Australia, it is happening in the United States, and I think it means that Government agencies are going to have to assume a greater and greater financial responsibility in the future.

Senator Kinnear: I believe that to be quite true, because it is very difficult now to get volunteers to go out, because they are coming around to the idea it should come out of general taxation. Anyone in that field knows that you cannot get the volunteers to do the work.

The Chairman: Senator Thompson?

Senator Thompson: I was, just wanting to ask this from your remark about the crippled children: one of the things we found out with NRC was that, almost spontaneously apparently, the informality of the relationship between two Ottawa surgeons and scientists, the scientists talked to the surgeon and then apparently went to . . .

Senator Sullivan: The brain cooling.

Senator Thompson: The brain cooling and a couple of other areas. In England apparently they have tried to co-ordinate this. They recognize there is a gap which is really between the best medical and technical brains, and the scientists and engineers who could develop new techniques, and they have set up an institute—and I am quoting from this—the Bath Institute of Medical Engineering with an eminent British scientist, Sir Laurence Wallace. The idea is to co-ordinate all manufacturing companies and medical people in Bath University, and they are finding that apparently once the surgeon and the engineer are working together harmoniously there are remarkable achievements—I am quoting from this article—that include the electronic heart pacemaker, artificial limbs and prototype versions of the artificial heart, and so on. I have the feeling that we have done nothing like this in Canada.

This article further goes on to say that a scientist went with doctors to look at the medical equipment used in respect to births, and was appalled at the home-made equipment that they were using, and is now working on trying, in harmony with the doctors, to develop new equipment. Now is this an area where the Medical Research Council could play a part?

Dr. Brown: There is a good deal going on actually, and much more is on the way already. There is a Institute of Biomedical Electronics at the University of Toronto which brings together medical people and engineers. There is a comparable group at McGill. In the Department of Physiology at the University of Montreal, two of the staff are trained engineers.

McMaster is building up a large institute with tentacles into industry, or tentacles of industry into it, and they are after just the sort of thing that you have in mind. Saskatoon was one of the first to get under way in an organized fashion in this field. Actually there is a good deal going on, and, as I mentioned earlier, I think it is a field that should have as much support as its people can use well.

Senator Thompson: Who should initiate this, doctor? Do I gather you think it should just come from individual companies, or could you have something in your grant structure with respect to this, or should it be a development of Welfare, or who?

Dr. Brown: We have indicated our interest by setting up a Grants Committee in this area, which is a way of saying to people pretty effectively that we are prepared to support work in this field, and indeed the existence of this committee can be taken as a positive encouragement. That sort of thing can be done. To quite an extent the initiative too must come from within the university, because it is within the university that a large part of the work must be done.

Dr. Salter: Mr Chairman, may I comment on the question also? In the University of Toronto, as Dr. Brown has mentioned, in the Department of Biochemical Engineering, the man at the head of this is a medical doctor and also an engineer. More and more, I think, in the future we will see men who have both disciplines. We have one such now in the Hospital for Sick Children, and there is a very large interface between these two disciplines: we can learn a great deal from one another. As an example of the application of engineering principles to medicine, I think that the thalidomide tragedy—and there were seventy children involved in this country—has really brought it into focus. The man who is the head of this aspect of our work in Toronto, Mr McLaurin, who had been in the United States, was attracted back to Canada to tackle this problem, and has developed many ingenious devices for this small group of children who had been born without limbs or with one or more limbs missing.

The reason for mentioning this story is that it emphasises the importance of adequate funding. When this tragedy occurred the Canadian Government gave a great deal of money to deal with it. It was a tragedy that brought about the need for a great deal of money, and as a result of that money being available, it was possible to do a great deal of research, particularly on the engineering aspects of this work, and this particular group of children have received treatment that they would not have been able to receive a few years ago. In addition to that, however, children all over the world have benefited from the research that was done for this great problem, because children have always been born with abnormalities of various types, including missing parts of limbs, or missing entire limbs; so the spin-off from that program is of value to everyone

throughout the world, and it was only possible because the Canadian Government recognized the tragic situation and gave a great deal of money to meet it.

Senator Thompson: I am just thinking again of the NRC and this informal relationship between two Ottawa surgeons and NRC scientists. Should there be any formal kind of mechanism set up so that you can use the work of these scientists more fully?

Dr. Salter: I do not think it needs to be any more formal than it is at the present. It is initiated by either the doctor or the engineer, to put it in its simplest terms, and often by both. Two men of intelligence in trying to solve the same problem are likely to be able to get along well in their efforts to do it, and each brings his own particular skills and knowledge to it. I do not think it needs to be formalized in any specific way. It is possible right now, and it is going on to a great extent in this country, this type of co-operation which you are concerned might not be happening in Canada.

Senator Thompson: I am really thinking of what you said about there being an incident of Government intervention by the provision of funds in connection with thalidomide children. I just throw this out: assuming that the NRC with the Medical Research Council had some arrangement with a group of engineering scientists who were to go across Canada to meet with surgeons, to look at equipment, to hear some of the problems of surgeons, this would be a more concerted effort than just the informal meetings between a doctor and a scientist who might be social friends.

Dr. Brown: There is a great deal of this, Mr Chairman. It is true that the project regarding brain cooling may have arisen at a cocktail party, but I do not think it is true that all projects arise in that way. Some of the very best do! But I think the sort of thing you are after actually is under way. Quite a number of institutes have been formed to bring together formally engineers and doctors; but one cannot bring together all engineers and all doctors, it must be by groups. I think actually a good deal of it is under way within an organizational and an administrative framework.

Dr. Salter: Would you not agree also that in the postgraduate training of either a physician or a surgeon the bio-medical engineering faculty do in fact participate, so that there is a good deal of dialogue between these two groups now.

The Chairman: I have a couple of questions; I do not know if you would like me to ask them. I would like first to come back to research in the drug industry. In our contacts with the drug sector, when we invited companies and universities to prepare briefs for this committee, I got one letter—I will not reveal the name of the company, though I am sure that you might

detect it quite easily—and these are two paragraphs from that letter:

From the standpoint of our own Company, we feel that it would be unrealistic to submit a brief in this connection in view of the fact that Bill C-102 which is at present being debated in the House of Commons will undoubtedly have the effect of seriously curtailing any contemplated expansion of pharmaceutical or fine chemical research in Canada.

Traditionally we have done the entire research for all our U.S. and foreign affiliated companies in Montreal and today we are one of the most highly developed pharmaceutical research organizations in the world, employing a total of more than 300 scientists. However, about a year ago we had a choice of either expanding our existing pilot plant and veterinary research facilities in Montreal, or of building new units in Rouses Point, New York. It was decided to build these facilities in Rouses Point because of our belief that the present unfavourable attitude of the Federal Government towards the drug industry could be very detrimental to our future development in this country.

My question is: are you aware of this problem, and are you prepared to give your own views about this? Is this a real problem, and who is looking after that aspect of that legislation? I do not want you to give your opinion about the legislation, but I am just wondering if there is somebody within the federal Government looking after this particular problem which is directly connected with research in the field of medicine?

Senator Sullivan: I hope they look at page 385 of the MRC report.

Dr. Brown: Mr Chairman, the Council does not have an opinion about this problem in an overall sense, because it involves the economics of the pharmaceutical industry, and this we have not studied, and opinions about the plea put forward here do not have much value unless they take into account the economics of the situation.

The Chairman: So you are not too worried about the situation that could develop with regard to its effect on research in Canada?

Dr. Brown: No, no, I have not said that. We would look on a major decrease in industrial research in the medical field as an unfortunate thing, but, as I have said, it is not within our sphere. We do not have the capacity to look at the impact of the bill on the research effort. That involves things that are not within our field.

The Chairman: That is where the scientist is not yet in a position to advise Government on science policy?

Dr. Brown: If you are talking about the group of scientists with you this morning, that is absolutely right, because it is not within our assigned area.

The Chairman: As far as I am concerned I have only one final question, and this is related to your committees. I notice that you are about to set up a Grants Committee on psychology?

Dr. Brown: Yes.

The Chairman: What kind of program do you envisage there which would not come into competition perhaps with what is already done in this field by NRC and the Defence Research Board, because, as you know, they are giving grants to research in psychology.

Dr. Brown: Yes, indeed. The MRC role in psychology is not new. There were no names on that particular sheet under the heading of psychology because a new committee was being formed. Actually we have been in this field for some little time. Naturally enough, clinical psychology, particularly when it is done in medical school settings has been supported by the Medical Research Council for a long time, and the National Research Council Associate Committee would not want to support this sort of clinical work. The Defence Research Board would support it only if it had high relevance to their mission. So there is no duplication of effort here.

In addition, the Medical Research Council supports some work in experimental psychology which involves biochemistry and physiology, and is thus to some extent inter-disciplinary. Actually it took on this responsibility a number of years ago when the funding situation for psychology as a whole looked rather bad and the threat of the removal of large amounts of American money hung over the field. We have stayed in the field in a small way, and the work we support is, as I mentioned, for the most part, inter-disciplinary in this sense. So that it is one of those interfaces with fields around us in which we have a very real interest and are prepared to consider applications.

There is also, of course, the interesting development that more of psychology social sciences of various sorts in the university administrative sense may be moved within faculties of medicine. This, then, by definition of our assigned function at the present time, will bring the part that moves within the sphere of responsibility of the Council.

The Chairman: What about psychiatry?

Dr. Brown: Very much.

The Chairman: You have no committee?

Dr. Brown: No. It is not segregated. The psychiatrists on our Grants Committee work under the head-

ing or the title of the Clinical Investigation Committee. That is where they function.

The Chairman: Senator Thompson?

Senator Thompson: Could I ask Dr. Brown about page 11 of your brief? I seem to have two conflicting points of view on that. In the top paragraph, at the end, you say:

It is necessary to have a group. . .

this I presume is an advisory group of scientists. . .

whose task it is to synthesize, and, when required, to resolve conflicting views.

Then in the next paragraph you say:

Science advice to government should be multiple, for it would be dangerous for it all to come through one final common pathway.

That seems to me to conflict with the statement which you make up above. You then go on to say:

The general policy of the government in science matters should not have only one point of origin.

I appreciate the one point of origin, but you are suggesting that science advice to government should be multiple, and further up you are saying that it is necessary to have a group whose task it is to synthesize and, when required, to resolve conflicting views. Could you clarify that for me?

Dr. Brown: Yes. I do not think there really is any contradiction, Mr. Chairman. The point made here is that there is need for science advice or advice by men who know science, which is a different thing. There is need for both of these things but we are thinking of the second at the moment.

The Chairman: But in those paragraphs you are really saying that, of course, we should have national policies by all sciences, and that insofar as that contribution of scientists is concerned it should, of course, be decentralised; but when we come to policy for science, it is it seems to me a completely different thing. There are two roles of the scientist, as adviser on what contribution science can make to policies, but there is also a policy for science. This is the distinction which has been made by various groups in France in particular, *La politique pour la science et la politique par la science*. You are arguing here that, of course, so far as we have a policy by science, it should be decentralised, and I think you are right; but you do not seem to have considered here—and it is no criticism of the brief—the other aspect, a policy for science.

Dr. Brown: Yes. It has been considered, but I think the consideration led to the view expressed

here, that a science policy is something that is multiple.

The Chairman: It certainly is.

Dr. Brown: And one perhaps cannot have just one policy for science. We would have thought one has to bring to the various points at which various policies are being decided the input which comes from people who have the training and knowledge of science, and then this additional point, that there is need for input by people who are part of the governmental process; not just input by organizations which have considered it only from their own particular aspect or from only part of all the features of the thing. The plea here is for the integration into the decision-making process, which is a lay process—not a scientific process, a lay process—the incorporation into this lay process of men who know science, what is going on, what can be hoped for from science, what at the present time cannot be hoped for from science, and to get them right into the centre of the decision-making process.

The Chairman: It is a plea for having science advisers like we have economic advisers.

Dr. Brown: Yes and, in addition, to have an increased number of people who are not advisers at all in this specialized sense, but are senior administrators and so on, who, instead of taking a degree in greats, have had a degree in science and know this language and know this method of thought, which is quite different. Now as there is more than one policy, and as science has its effect on almost everything, it follows perhaps that there is a need for these people and this sort of advice on a completely integrated basis—not on an ad hoc basis but on a completely integrated basis—at many points in the complicated decision-making process of government. That is the first point that was made, and then it is suggested that there is a need in addition to this for a concentration of this sort of talent, which is an integral part of the mechanism, not a replacement for the other people. In the matter of wording here, we might have re-worded it a little bit: the suggestion was not that this group would synthesize everything, but there would be occasions on which it would be necessary to bring together the demands of different policies and examine them from this point of view, or to bring together advice which had been given from this point of view from several places about one policy, and then synthesize it. They are complementary and are not contradictory, in the sense that one does what the other would do.

Senator Thompson: Thank you very much. Could I say from my point of view the concern that I have had in listening to our witnesses is really about financing for research, and the lack of financing. I

think this is affected, as Dr. Brown in his opening remarks stated, by the fact that research has so many ramifications extending, like Dr. LeClair has mentioned, into the medical schools. You do not get medical schools, effective ones, if you do not have researchers.

The other concern I have is this, and I don't really know how this works. It seems to me that in Canada we are saying that voluntary agencies, medical associations and others have the responsibility of getting medical care to the patient, and medical care, I assume, means that the doctors should have up-to-date knowledge concerning new research. I suggest that there are going to be changes in the role of the doctor and the role of hospitals, in the use of computers and a whole variety of things. I just wondered who is actually looking at all this, and in order that we can get the most efficient medical care to patients. From what I gather, you do not see this as your role, and I assume this is the responsibility of the Department of Health and Welfare and the medical schools.

Dr. Brown: No, Mr. Chairman, our assigned role is the support of research, not medical care.

Senator Thompson: Are you concerned about this secondary thing? I am thinking of a study done in Ontario, for example, of the private practitioner by doctors, which was not open to the public, but we understood that they were not overly happy about it. I am thinking of the Gundy report, which indicated that we cannot be completely complacent about the standard in the various schools across Canada, and so on. Does this concern you, that the people responsible feel that there should be more co-ordination, even though it is not your particular area of responsibility?

The Chairman: You might be concerned, but you cannot do very much about it.

Dr. Brown: Mr. Chairman, I would like to say again that the Department of National Health and Welfare is doing a great deal in the field referred to in the first part of your last statement, and it is there that the function and responsibility lies; and they are being quite active about it. I think there is a good deal going on.

Senator Thompson: Thank you.

Dr. Salter: Mr. Chairman, I think it is also fair to say that the standard of the medical schools has been improved a great deal by Medical Research Council activities, and this is the role that we have to play in relation to the medical schools, to improve this aspect of their total function. The medical school has a primary responsibility to improve pa-

tient care and teach the next generation of doctors. They can do this better if they have teachers who are also doing research work. I think this delineates the responsibility somewhat, and each one of us wears different hats: we are teachers, we are surgeons, we are scientists, we are administrators and whatever. So we do have a concern, but in relation to MRC activity, I think we have to keep our focus on our primary job, which is to support and encourage research in this country.

Senator Thompson: I appreciate that.

The Chairman: Well, it is one o'clock unfortunately. We will have to adjourn, but before doing so I certainly want to thank you, Dr. Brown, and your colleagues for having been with us for three hours, and also for having agreed to adjust to a change in schedule, and appear this morning rather than this afternoon.

Dr. Brown: It was no trouble at all.

The Chairman: Thank you very much.

The committee adjourned.

APPENDIX 31

MEDICAL RESEARCH COUNCIL

A BRIEF SUBMITTED TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF
THE SENATE OF CANADA

OTTAWA

1968

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APPENDICES

- A. Membership of the Medical Research Council
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PART I

1. Introduction

The Medical Research Council is that part of the government structure which is the main vehicle for the federal support of medical research. Its assigned aim and objective is the improvement of the health of Canadians through the development of research.

The Council itself is a group of working scientists, 21 in number, who have had delegated to them responsibility for the expenditure of a large part of the funds which Parliament appropriates for medical research. There is a small, a too small, secretariat, and there are numerous working committees which report to Council.

In Canada, where the amount of medical research done in industry and government laboratories is relatively small, the main body of medical research is carried out in universities and affiliated institutions. The Medical Research Council does not have laboratories of its own, and it uses the funds appropriated to it to promote and support research in universities, hospitals and research institutes. It now provides to the universities more than 60% of the extramural support for medical research which reaches them from all sources.

2. Policies of the Medical Research Council

Within the limits imposed by its assigned objective, the Medical Research Council has had the authority to establish policies and regulations regarding the use of monies appropriated to it by Parliament, and for policy-making and programming purposes it has selected three goals:

- a) to contribute to new knowledge in the health area,
- b) by the support of research, to develop and support the scientific and technological back-up to the provision of health care which is necessary if health services are to be of high standard, and
- c) to develop and support the research component in the education of health care personnel.

About 70% of the funds available to the Medical Research Council are used in supporting specific research programs directed by scientists across the country. These research programs are in part basic research, pure and objective, in part applied research and in part developmental research. They range from projects carried out in departments of chemistry, physics, biology and engineering, through those carried out in the basic science departments of medical schools, to the most applied and developmental type of work at the bedside and in the laboratory. The initiative in these projects lies with the researchers who direct them. The criteria used in selecting projects for support are almost entirely associated with the scientific merit and promise of the proposal and the responsible investigator.

Within the broad field of medical research the Medical Research Council has only occasionally set aside specific amounts of money for the support of work in the various sub-fields. It has, however, encouraged work in promising fields by establishing grants committees in those fields.

Within the past two years the Medical Research Council has taken the initiative in two specific projects and has sought, and found, the cooperation of scientists in their execution. These are (1) the MRC Therapeutic Trial of Human Growth Hormone and (2) the MRC Antilymphocyte Serum Project. In both these cases there was a need to move on a national collaborative basis towards the solution of important problems, in one case the assessment of the effect of human growth hormone in various types of dwarfism, and in the other the determination of the effect of antilymphocyte serum in patients receiving organ transplants. It is the plan of Council to continue this type of stimulatory and coordinating project when there are health research problems best dealt with in this way.

Over the years the Medical Research Council has spent a very significant proportion of its resources in the training of research workers and teachers for our medical schools. At the present time it supports, for example, about 300 research trainees at the postdoctoral level and some 225 at the predoctoral level through its Fellowship and Studentship Programs. In addition many others are paid from MRC project grants held by senior investigators. Funds for training have always had the highest priority and the results have been most gratifying. For instance, an increasing number of faculty members are one-time MRC Fellows.

The Medical Research Council has been very much concerned with the special need to develop medical research in Canada in those areas where the level of research is inadequate. The main programs are now so highly competitive and, of necessity, so scheduled in time, that they do not always lend themselves readily to the rapid response to special requests for funds to attract qualified personnel or to the provision of "start-up" funds for the projects of newly appointed faculty members. To offset this, and to encourage local leadership, the Council has established a system of development grants with the main objective of facilitating the recruitment and establishment in operation of first-class researchers. Council also provides general research grants to deans of schools of medicine and pharmacy and, beginning in 1969, to deans of schools of dentistry; these grants are used at the discretion of the dean to deal with local problems. Finally, as another means of developing strength where it is specially needed, Council plans to use its Associateship Program which provides for the salary support of a limited number of established and highly competent investigators.

The success of the Council lies in the achievements of the researchers who have been supported by it and in the improvements in health care and education which they have brought to the institutions in which they work. Little of the research supported by the Medical

Research Council is susceptible to cost-benefit analysis in the usual terms, but some idea of its benefits may be obtained by imagining what our hospitals and professional schools would be like if there were removed from them two-thirds of the research and the researchers who presently exist there. In such a situation the standard of diagnosis and treatment would be much lower than it is now, and the teaching would be that provided by those who are not at the forefront of their subjects but are retailing, without critical assessment, that which has been produced elsewhere.

3. Legislative Basis for the Medical Research Council

It was in 1937 that General A.G.L. McNaughton, then President of the National Research Council, announced to a meeting of Council that an Associate Committee on Medical Research would be established and asked Sir Frederick Banting to be its chairman. The device of the Associate Committee served the needs of medical research until 1946 when a Division of Medical Research was established within the National Research Council. In 1960, following on the Farquharson Report, Cabinet directed the National Research Council to establish a Medical Research Council as an autonomous body within the administrative framework of the National Research Council.

Operating under the National Research Council Act and with the powers and responsibilities that it provided, the Medical Research Council has moved from an organization that was essentially a grants committee and a fellowship selection committee to its present form, which is characterized by a wide variety of programs designed to stimulate and support good research in the health sciences. The details of the present organization are set out later in this brief.

In July 1968 the government announced its intention to have the Medical Research Council report to Parliament through the Minister of National Health and Welfare rather than through the Chairman of the

Privy Council Committee on Scientific and Industrial Research, as it had done under the National Research Council Act. At the present time the Medical Research Council is a department for purposes of financial administration. This is a temporary situation to be brought to an end by legislation.

The Medical Research Council has given a great deal of consideration to the matter of legislation, and it is strongly of the opinion that its responsibilities within the broad area of a national program for medical research can best be discharged if it has in the future, as it has had in the past, the form, functions and authority of a corporate agency. Corporate agency structure is the type of government structure which will provide the greatest degree of flexibility, coordination, and economy of operation.

A working Council in the framework of a corporate agency can be used to ensure a continuous input of informed opinion for both policy-making and administration of policy. The members of Council bring to their work the knowledge and judgment which can come only from those who are active scientists. Because of their duty to administer a national program, their work has about it a character which only responsibility can bring.

Much experience in several countries has shown that the government support of basic science is best provided through a council and corporate agency type of structure. There are autonomous Medical Research Councils in the United Kingdom, Sweden, New Zealand, India and Pakistan. In the United States, the National Institutes of Health are part of the Department of Health, Education and Welfare and this arrangement has been the subject of criticism. Recently the N.I.H. has been raised from "Bureau" to "Agency" status and no longer reports to the Surgeon-General but directly to the Assistant Secretary.

The delegation of responsibility to a corporate agency makes possible a flexibility in the conduct of programs, and it can also facilitate coordination. It makes easier the recruitment of scientific personnel. Judged by the record of the Medical Research Council it permits an astounding degree of economy of administration.

It should be emphasized that corporate agencies operate within prescribed terms of reference. Their proposals and programs are reviewed regularly by Treasury Board and other parts of the government apparatus. The development of programs and associated proposals for funding require the approval of the Minister to whom the agency reports. In operation, a corporate agency functioning in the way the Medical Research Council has been functioning is subject to the usual supervision of the Comptroller of the Treasury and the Auditor General. In essence, there occurs centrally the assignment of the main responsibility, and the authority and powers to develop policies and administer programs within assigned areas are delegated to the periphery.

4. Government Organization for Science

Consideration has also been given to the forms of organization and the channels of communication which the government must have if science and technology are to be exploited to the full. The conclusion reached has been that this can be accomplished not by any single step or in any simple fashion, but rather by a number of changes, some of which will take years to bring about.

Science, or science and technology, is not a part of our life, or a part of the life of the nation, that can be isolated and decided about at one time and in one place. It is an essential and all-pervading aspect of our lives, and interacts with all other types of activity. Also, and this is often forgotten, decisions taken in other areas of our community life have their effect on science, and this in turn has a feedback effect on the area of the original decision. If science is looked at in this way,

it will be realized that policy decisions taken primarily because of their effect on science have their effect on other areas, and that decisions taken on apparently non-scientific matters will often have effects on scientific and technological activities.

There is nothing new about this. The decision to support the construction of the first transcontinental railway involved assessment of the technological as well as the commercial aspects of the proposal. The success of the technological and financial efforts quickly had its feedback to science at the research level. For example, the opening up of the West by the railways gave rise to the necessity to develop varieties of wheat which would grow and mature in the climate of the West. Some of these varieties produced wheat with milling qualities that made it sought all over the world. This led to huge commercial benefits, and one of the many circular effects arising from the original decision was complete. It may also be remarked here that the decision to support the building of the CPR represented a decision in the technological area which was of great magnitude compared with some recent decisions affecting science and technology.

As one thinks of science, it should be realized that it is much more than research. In addition to research and invention, it includes that great effort needed to move from invention to innovation when new knowledge immediately relevant to social needs is followed by industrial production; here it is inextricably mixed with managerial decisions and attitudes. Science is, as well, the application of already available knowledge to the solution of problems. For example, in the field of pollution it is fair to ask whether early and important amelioration of pollution will come from the application of what is already known, or from research which has yet to be done. Science is more than research. It is above all a way of thinking, a way of analyzing and isolating problems and then proceeding to the elaboration of hypotheses which can be submitted to test.

Canada's science policy will be on the right track when more of those who make our policy decisions have some experience of science, understand the scientific method, and can recognize the difference between a social or natural or physical problem which is not yet amenable to scientific solution and a question which scientists are ready to answer if they are given the means. When there are as many in the government and the government service who have a training in science as there are with a training in economics or political science, the national problem with science will be less acute.

The problem is to bring as much as possible of the nature of scientific problems and opportunities, and of their social costs and benefits, to the minds of those who in the last analysis make the large decisions. Policy decisions are made by politicians. There is nothing special about decisions affecting science and even if there were it would remain necessary to have these decisions made by politicians. As it will be some years before a high proportion of our politicians and senior administrators have a significant knowledge of science and the scientific method, it is necessary to find means of putting beside them men who can bridge the false gap between science and politics.

It is important in thinking about the elaboration of a policy regarding science to remember the distinction between those who give advice often knowing only part of the picture and those who must take decisions after trying to balance all factors, scientific and otherwise. On the one hand there are those who elaborate advice, and on the other hand there are those who must move from advice to decision.

It is perhaps a too common belief among scientists that their advice regarding policy should almost automatically be accepted as a policy. There are obviously different levels in the elaboration of advice about scientific and technological matters. First of all, groups of scientific workers with special interests should put forward their views with force and argument. This is a necessary part of the process, and

such advice should not be underrated or referred to in a derogatory fashion as special pleading. Examples of this sort of advice would include the submissions by national societies representing individual disciplines and the submissions by institutions or groups of institutions representing some of the main sectors in which research is carried out.

Then we move to advice which we say is at a higher level simply because the constituency represented is larger and more diversified. Here we may take as examples the advice given to government by agencies such as the Association of Universities and Colleges of Canada, the Association of Canadian Medical Colleges, the National Research Council, the Canada Council, the Medical Research Council and the Atomic Energy Control Board. Such advice comes largely from active workers in the areas involved who have opportunities for periodic discussion in depth of the questions at issue. The grasp of the problem should be larger here, and the view taken should be broader.

Now, in Canada, we have a Science Council which has as its base all scientific activity. Here again, the advice should be more refined than at either of the other two levels, but it will still be advice which argues from the point of view of science, as of course it should. Its advice will not always be based on knowledge of the complete context in which final major decisions have to be taken. One very simple reason why this will be the case is that from time to time there will be information which must go into the final decision-making process that the government cannot make known to the twenty-four scientists who are the Science Council. One expects that an efficiently operating Science Council will provide some of the most helpful advice to government, but both the scientific community and government itself should realize that, no matter how efficient, the Science Council cannot make policy; it can only give refined advice concerning it.

Lest the division into three categories for purposes of this discussion be misunderstood, it should be emphasized that there should never be a hierarchical arrangement imposed on communication between different parts of the scientific community and the government. Each part should have the opportunity to send its opinion to the centre without what may be considered filtration through one of the inner rings.

The most difficult part of the problem is at the centre, at Cabinet level. Its solution would seem to lie in confidential and intimate scientific advisors who on the one side have open and free lines of communication with the Science Council and other bodies, and who on the other communicate with the politicians with a freedom which only mutual confidence can bring. This is the most difficult part of the whole problem to organize. It is also its most essential part.

These advisors, who would be closest of all to the points of decision-making, closest to the Cabinet Ministers, should not exist within only one cluster. Many of them should be dispersed and work intimately on a day-to-day basis with those whom they advise. They should be privy to all the information which the Ministers and their other close advisors will have to take into account when evaluating policy alternatives. That dispersal of this sort should be thought necessary follows from the argument that science affects the greater part of our lives. Such dispersal would accomplish two main results. It would first of all increase the contacts of science advisors with those who have policy and administrative responsibilities; it would increase their knowledge of areas in which it is desired to achieve optimal results by the application of science and technology. It would, secondly, increase the number of points at the policy-making level where science advice would be fed in and evaluated by non-scientists. Dispersion would, then, increase the number of points in government where science policy would be critically developed.

It is also necessary, for several reasons, to have a clustering of such science advisors. It is necessary for organizational reasons, for the maintenance of continuity, and for the establishment of a chief focus of capability for some broad studies in depth. It is necessary to have a group whose task it is to synthesize, and, when required, to resolve conflicting views.

Another reason for dispersal of the science advisors should be mentioned. Any one of us may be at the mercy of a single expert advisor in a field with which we are not familiar. As soon, however, as we have two expert advisors, and therefore the opportunity to listen to them as they carry on their dialogue, we greatly increase our ability to judge wisely. Laymen can judge between scientists who argue, but they have difficulty when they always speak in unison. Science advice to government should be multiple, for it would be dangerous for it all to come through one final common pathway. The general policy of the government in science matters should not have only one point of origin; it should have multiple foci of origin with the final large decisions being made on a group basis.

5. Immediate Problems in the Health Sciences Area

This part of our submission may be concluded by raising some of the problems which are apparent now in the health sciences area. Our approach to them and their possible solution will be speeded up by improvements in the country's, and the government's, general attitude towards science and the use of it.

It is perfectly plain that Canadians want a high level of health care. High standards of care consist essentially of the delivery at the points and times needed of up-to-date knowledge and experienced opinion. This is partly a scientific and partly a managerial problem, but our emphasis will be on the scientific aspect.

The provision of high level care means among other things a narrowing of the gap between discovery and application of new knowledge

and new methods. It is obvious that the largest part of the knowledge to be applied at the bedside to-day, and the largest part of the new knowledge to be applied during the next five to ten years, will come from outside the country. As patients, or as a government, we cannot simply buy this knowledge, though it has its costs. As a community, however, we can support those who will acquire it rapidly, and apply it quickly when and where it is needed. Those who do this for us are those who are at the forefront of their subjects and know the methods by which new knowledge is acquired. These are the medical research scientists and it is their presence and their effect in communities of practitioners which will help to ensure that what is known is used. These men and their teams of workers provide the scientific and technological back-up to health care and we need to increase their number quite significantly.

Canada now spends at least \$2.8 billion annually on health care. The extramural money going into medical research in universities and hospitals, to take the largest component of health science research, is \$44 million. The ratio is wrong and it needs examination in its social, financial and scientific aspects.

Another large problem in our field is that of the staffing of our professional schools. In the sense that the total number of their products, the trained professionals, are too small, they need to be increased in number and perhaps in size. There are plans on foot to repair some of the deficiencies. In the medical field it is hoped that the Canadian output of trained doctors over the next five years will increase from 1,116 to 1,320. The establishment of four new medical schools and the enlargement of others will require large additions to faculty strength. There is the additional fact that the research component of some of the existing schools causes concern because of its inadequate size. The creation of new schools of dentistry and pharmacy, and the enlargement of existing schools, will mean additional demands. These are the main dimensions of an expansion which has to be accomplished if Canada is to produce anything like a

sufficient number of practitioners who are adequately trained and who can bring science to the bedside and there mix it properly with all the non-scientific support which patients require. Recruitment of faculty to train these doctors means the recruitment of a large number of researchers and of men who have experience with research. It has been reported to the Medical Research Council that in the quinquennium 1967-72 the number of investigators will increase from 1,365 to 2,596. The essential feature of the expansion is the people concerned, but, if they are to be persuaded to appear, new and improved facilities and the means to work will have to be provided. Both new space and new money are needed.

Two other problems may be mentioned as examples. There should, for instance, be a good hard look at the field of biomedical engineering. The field is ripe for advance. There are increasing numbers of medical scientists who want to bring to their problems the methods of engineering, and there are increasing numbers of engineers and physicists who want to use the tools they have to serve biomedical ends. The field is ripe in its scientific development and the people are ready. Their means of support and organization have still to be worked out. If biomedical engineering develops in a healthy, well-rounded fashion, medical scientists and industry will be brought closer to each other. This will be of particular importance in a country where the industrial component of medical science is so small.

As the last example, it can be stated that the interface between health science research and sociology and economics must be examined. There should be developed organizations and approaches to health problems which will replace the present interface with a borderland of cooperation. Again, if this is to be done, there are important policy decisions to be made by the government about methods of stimulating, supporting and promoting research in these contiguous areas.

PART II

1. Organization(a)
Organization"Recond of Cabinet Decision

Meeting of June 30th, 1960

Support of Medical Research

The Cabinet approved the recommendations of the Privy Council Committee on Scientific and Industrial Research that the government should announce

(i) that the National Research Council was being instructed to establish its Division of Medical Research at this time as virtually an autonomous subsidiary, to be designated the Medical Research Council, within the framework of the National Research Council; and

(ii) that, in the light of experience, further consideration would be given to the question of the appropriate time when Parliament might be asked to approve the detachment of the Medical Research Council from the National Research Council;

.....

(Sgd) W.D. Halliday

Registrar of the Cabinet "

The above Cabinet Decision was implemented by the National Research Council at its 208th Meeting in November 1960, and the Medical Research Council continued to operate on this basis until 1968.

The Medical Research Council now reports, through its Chairman, directly to the Minister of National Health and Welfare but is quite independent of that Department.

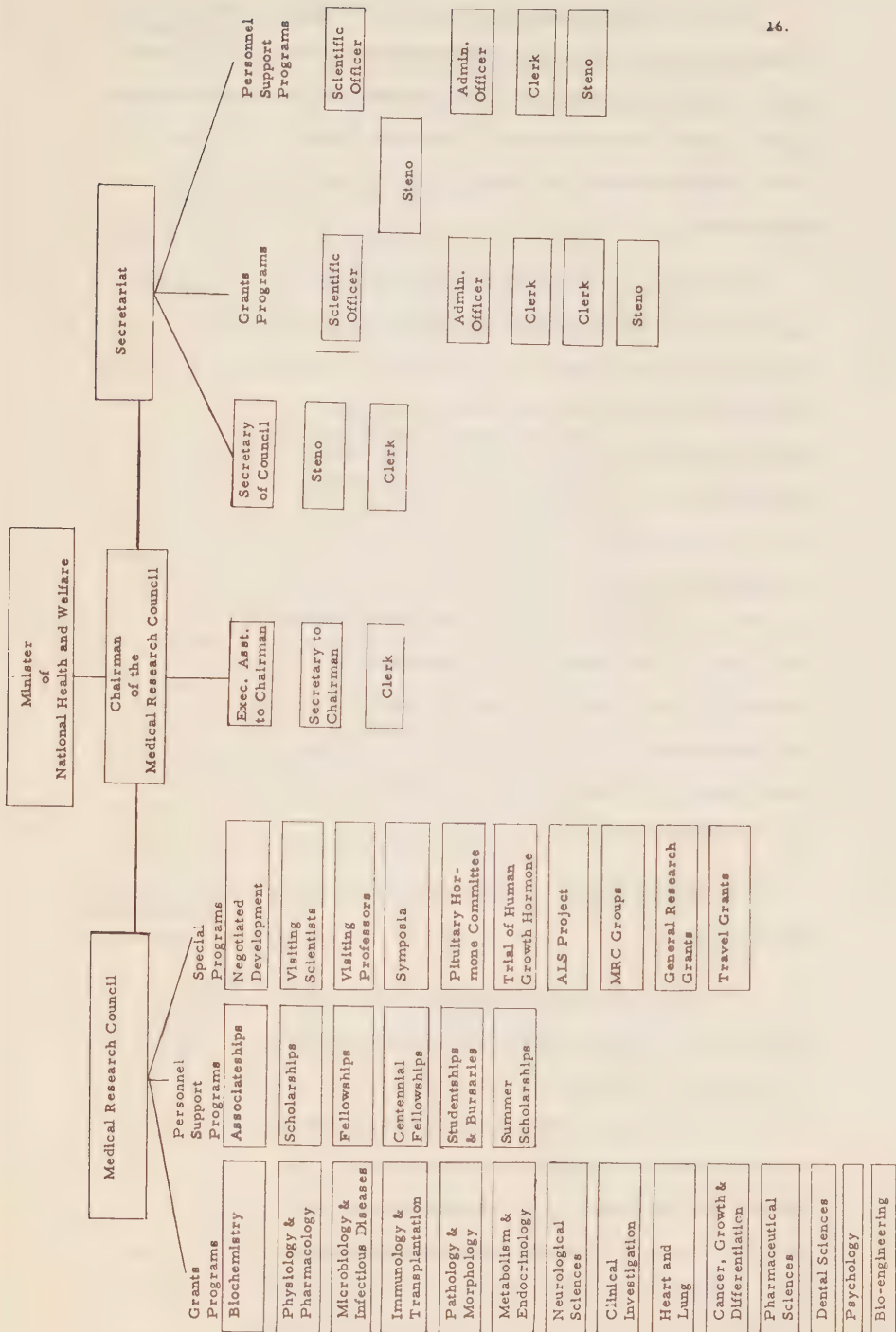
The Council itself consists of twenty-one members (see Appendix A) representing all major aspects of health science research; the number has recently been increased by the addition of three representatives in the field of dental research since this area will become the responsibility of MRC on April 1, 1969. With the exception of the Chairman, who holds his appointment during pleasure, Council members serve without remuneration for periods of three years, with the possible renewal of their appointments for one additional term.

Council is supported by 20 standing committees, comprising approximately 100 additional senior scientists, on whom it relies for expert advice and recommendations in the operation of its various programs. The nature of these committees and their composition is recorded in Appendix B.

The Council's full-time secretariat, in addition to the Chairman, now comprises 15 staff members.

The Medical Research Council does not operate laboratories of its own; its program is oriented towards the development and support of research in the health sciences in Canadian universities, hospitals and research institutes, and the training of research personnel in its areas of responsibility.

The organization of Council and its activities is shown in the following Chart.



Special Committee

The Medical Research Council does not have formal arrangements or agreements with organizations outside of Canada. It does however maintain liaison with similar agencies of other countries through the exchange of annual reports, correspondence, and informal visits arranged as the need arises.

(b)
Agreements

The nature and diversity of Council's Personnel Support Programs provides opportunity for informal exchanges of scientific personnel for varying periods. Under the Fellowship program, foreign graduates may take advanced training in research in Canadian laboratories and Canadian Fellows may hold their awards outside Canada if it is in the best interests of their training to do so. The Visiting Scientist program offers opportunities for collaboration between Canadian and foreign investigators at a more senior level. It was because of the availability of this latter program that Council was able to react so quickly to requests from Canadian universities for assistance in providing interim support for refugee scientists following the recent events in Czechoslovakia.

The Medical Research Council maintains no offices outside of Ottawa.

(c)
Overseas Offices

The Medical Research Council has until recently operated as an autonomous agency within the framework of the National Research Council; it has therefore had the statutory powers and functions provided in the National Research Council Act and has reported through the National Research Council to the Chairman of the Privy Council Committee on Scientific and Industrial Research. Under an interim arrangement made in August 1968 (Order-in-Council 1968-1709), the Medical Research Council is now

(d)
Functions

a separate body reporting to the Minister of National Health and Welfare; it continues to function as before pending legislation establishing its statutory powers and functions for the future.

Within the broad powers provided under the National Research Council Act, the Medical Research Council has had authority, subject to the appropriation of funds for the purpose, to "undertake, assist or promote" research in the medical sciences.

(e)
MRC Policy

It may be useful here to recall briefly the recent development of medical research. Although Canada had made many major contributions to medical research prior to 1940, it was not until the Second World War that there was any serious effort to fund research in this field. Immediately following the War, the 9 existing medical schools and the additional 3 schools established shortly thereafter were hard put to find sufficient teaching staff and without the part-time contributions made by practising clinicians would have been unable to do so. There was little time for a complementary program of research in most schools and Canada was forced to rely heavily on the advances and post-graduate training programs of other nations.

It was Council's decision at the time of its establishment in 1960, which it has since confirmed, to make every effort to "assist" and "promote" medical research in the universities and make no attempt to seek funds for the establishment of central laboratories in which to "undertake" research. To undertake research would have been to draw valuable manpower away from the universities where it was still in desperately short supply.

First priority was given to producing teacher-scientists to staff the growing medical schools. Medical Research Fellowships had been offered by the Division of Medical Research of the National Research Council since 1947. Under the same aegis, funds had been made available to the medical schools since 1956 to provide salary support for a limited number of career investigators who were expected to devote almost full time to research and graduate teaching; these programs were continued by the Medical Research Council and have been supplemented by other Personnel Support Programs.

In the past ten years there has been a very large increase in the number of medical school faculty members who have significant research capability and the programs of the Medical Research Council have made an important contribution to this growth. Because of the establishment of new schools, and major expansion programs in existing schools, even larger numbers of teacher-scientists will be required in the years immediately ahead if our medical schools are to be adequately staffed. The same may be said of schools of pharmacy and of dentistry.

Concurrently with the Personnel Support Programs, and of much greater magnitude from the financial standpoint, the Medical Research Council has operated a Grants Program for the support of research projects initiated and carried out by investigators in the universities, their hospitals and institutes.

In 1960, by far the greater part of the Grants Program was concerned with fundamental work in the basic sciences and relatively little attention was paid to the development of clinical research. Since that time there has been a major change in policy with the result that about one-third of the operating grants

now go to clinical researchers. The amount of work supported in developmental research has not been great but applications of this type are now being received in greater numbers. The Medical Research Council has changed, then, from an agency which was concerned primarily with work in basic sciences to one which provides support for work across the whole spectrum of health science research and development (with the exception of certain fields supported by other federal agencies).

It is also necessary to consider research related to specific national needs which is beyond the resources of individual universities. Whole areas of research will fail to develop unless special facilities are provided. Primate facilities, for example, are needed for studies in physiology, psychology, and dentistry which cannot be undertaken on other species with any degree of relevance to man. Drug testing facilities are needed to investigate the metabolism and toxicity of newly-synthesized drugs. Computer facilities are in increasing demand. The Medical Research Council has recognized the validity of these needs and it has established ad hoc committees to study them so that appropriate recommendations may be put before the government.

The Medical Research Council has supported two national clinical trials and to that extent may be considered to have "undertaken" research. These are the MRC Therapeutic Trial of Human Growth Hormone and the ALS Project to which reference will be made later.

In summary, the chief features of the policy of the Medical Research Council within its own area are

- to provide financial assistance for the research of investigators whose work is assessed by national standards,

- to support energetically the training in research of highly qualified young men and women,
- to support a limited number of career investigators, and
- to organize and direct a limited number of research programs.

The Medical Research Council now provides approximately 60% of all extramural support for medical research reaching Canadian universities and affiliated hospitals and institutes. In Schools of Pharmacy the percentage of extramural support coming from the Medical Research Council is much higher. Council also supports a small amount of research outside of faculties of medicine and pharmacy if the proposed research is of immediate relevance to medical problems.

2. Functions in Relation to Other Agencies and Institutions

The other federal agencies which, in their work, have interfaces with the work of the Medical Research Council are: the Department of National Health and Welfare, the National Research Council, the Defence Research Board, the Department of Veterans Affairs, the Department of Agriculture, Atomic Energy of Canada Limited, and the Canada Council. The Medical Research Council is prepared to consider all research proposals put forward by Schools of Medicine, of Pharmacy and, now, of Dentistry, with the exception of that work for which federal support is channelled through the Department of National Health and Welfare, and the Defence Research Board.

(a)
Federal
Agencies

The Defence Research Board has a specific mission in supporting research, both basic and developmental, which is directly relevant to defence.

The Department of National Health and Welfare administers a Public Health Research Grants program the scope of which is described as follows:

"Projects likely to be approved must show a direct relationship to the following aspects of public health:

- (a) Prevention of disease, disability or death,
- (b) Epidemiological studies,
- (c) Hospital studies (for example, administrative),
- (d) Community based studies in health and medical care,
- (e) Operational research,
- (f) Environmental health, including sanitation,
- (g) Training and utilization of health manpower resources.

Excluded from the Public Health Research Grant will be most research in medical sciences (either basic or clinical) unless there is a direct and early preventive aspect or some special relationship to the seven areas mentioned above..." *

Liaison with other federal agencies is accomplished through an Interdepartmental Medical Research Coordinating Group comprised of representatives of the Medical Research Council, the Defence Research Board, the Department of National Health and Welfare and the Department of Veterans Affairs, through an MRC/NRC Liaison Committee, and through frequent consultation at the administrative level between the officers of the Department of National Health and Welfare, the Defence Research Board, the National Research Council and ourselves. In addition, the Chairman of the Medical Research Council has been a member of the National Research Council, the Defence Research Board Medical Advisory Committee, the Department of National Health and Welfare's Research Advisory Committee to the Dominion Council of Health, and the Department of Veterans Affairs Advisory Board on Medical Research. It might be noted here that the Medical Research Council has recently acceded to the request of the Department of Veterans Affairs that applications for research funds directed to the Department be examined and assessed for scientific merit by the Grants Committees of the Council.

The Council's contact with industry to date has been (b)
minimal. It has not seen the need for, nor has industry requested Industry

* Dept. of National Health and Welfare - Research under the National Health Grants. General Instructions, 1968. pp. 2-5.

that it establish, a grants program in this area. There are no restrictions as to the type of industry eligible to participate in the Industrial Assistance Program of the National Research Council, which is primarily designed to encourage basic research in industry, or in the program of the Department of Industry, which is concerned more with applied or developmental research. Council is concerned however with the growth of research and development in the field of bio-engineering, and in its concern for this field it will be anxious to see that the industrial component is adequately supported.

When appropriate, the Medical Research Council has sought representation from industry on its ad hoc committees. It has also recorded its interest in having representation from industry on Council from time to time, particularly if it should prove feasible to establish one or two drug institutes in Canada.

The chief function of the Medical Research Council is to support research in educational institutions. The major initiative with respect to research in the health sciences lies with the universities, hospitals and institutes where it is conducted. Council's policy, and therefore its function, is to provide support for high quality work and to provide the incentives to encourage expansion and improvement where these are needed.

(c)
Educational
institutions

Council's activities are divided into three broad programs:

- a) Grants Program
- b) Personnel Support Programs
- c) Special Programs,

all of which are devoted to the funding of extramural research. The procedures for implementing these programs are outlined in section II, 11 (a) (page 37).

The Medical Research Council is the adhering body for Canada in the Council for International Organizations of Medical Sciences (an international coordinating agency with headquarters in Paris, the International Union of Physiological Sciences, and the International Union of Pharmacological Sciences. In consultation with the relevant national societies Council selects official delegates to the congresses of these two International Unions and to other international congresses in fields directly related to the other areas of responsibility of the Council.

(d)
International
responsi-
bilities

A number of voluntary agencies provide a significant amount of extramural support for medical research and over the years their contribution in money and leadership has been very great. In percentage terms their role is now diminishing but it will be to the advantage of medical research as a whole if the voluntary agencies continue to play an effective part. It is no bad thing to have more than one source to which researchers may look for funds. Multiple agencies mean that there is more innovation in methods of research support than there might otherwise be, and here the voluntary agencies have contributed importantly. As voluntary agencies they are sometimes able to provide support under conditions which a government agency cannot accomplish. One of the most important contributions of voluntary organizations has been their educational effort. In their campaigns for funds, as well as in their society efforts, they have done much to educate the Canadian public in the importance of medical research.

(e)
Voluntary
agencies

Liaison with the voluntary agencies is maintained through informal and numerous working contacts, the yearly meeting of the Interdepartmental Medical Research Coordinating

Group to which representatives of the national societies are invited, and by membership of officers of the Medical Research Council on the research advisory committees of seven of the major agencies.

Useful contacts are maintained with foreign agencies where required, both government and voluntary, for the Medical Research Council must adapt to occasional major changes in their policies as they affect Canadian research. For example the U.S. Public Health Service some years ago began to withdraw research support from Canadian investigators, often on short notice. To avoid disruption of valuable projects, the Medical Research Council moved quickly to replace this support (to the extent that funds were available) and to adjust the balance of its programs to take this withdrawal into account.

(f)
American
agencies

3. Review Procedures

The Medical Research Council employs several methods of review and revision of its programs.

The actual operating procedures are kept under continual scrutiny by a five-member Executive of Council which meets at monthly intervals. At these sessions close attention is paid to the current financial situation and adjustments are made if necessary between allocations in order to meet Council's commitments or implement its decisions; current policies are discussed, and consideration is given to new problems with a view to developing alternative courses of action to be put before Council.

Ad hoc committees are set up from time to time to review procedures and policy goals in particular areas. Two years ago, one such committee was concerned specifically with

the review of Council's procedures for processing and assessing applications for grants-in-aid. Three other ad hoc committees are now examining three different policy goals, i.e. primate research facilities, drug research institutes, and computer needs. The important ALS Project arose out of the preliminary studies of another ad hoc committee.

A Policy Study Group comprised of senior investigators from within and without Council has been at work for the past year reviewing the programs of Council, and its overall role in the promotion and assistance of research in the health sciences; it has recently presented its report to Council for its consideration.

The standing committees of Council send forward to Council their views on policy and their recommendations for the improvement of procedures. Some make special provision for discussion of policy and procedures at each of their meetings, and both the Committee on Fellowships and the Committee on Associates and Scholars have, within the past two years, met in extraordinary sessions to consider policy in their specific areas.

It should be noted that while the chairmen of the standing committees are not necessarily members of Council, every Council member is expected to serve as an active member of at least one committee of Council; they therefore have an opportunity to evaluate the effectiveness of Council policies at the level of the working committees. A member of the full-time staff serves as the secretary of each standing committee to ensure that uniform interpretation of Council's regulations is maintained. There is, then, effective liaison and coordination of the overall operation at all levels.

Procedures, and methods used to maintain surveillance of individual programs and projects are described in section II, 11(c) (page 39).

4. Outside Studies

To obtain up-to-date information on which to base its planning for the future, the Medical Research Council commissioned a Survey of Medical Research in Canada.

The first phase of this Survey took the form of an enumeration of all categories of research personnel in Canadian medical schools and their affiliated institutes, and the results were published in 1966 as MRC Report No. 1.

During 1967 the Survey was extended to an evaluation of the quantity and the quality of research in the medical sciences. The evaluation was made by 14 Assessment Groups, each comprised of 3 to 5 senior investigators in a particular discipline who visited the departments of the medical schools in their particular field to obtain first-hand information on work in progress, plans and requirements for space, personnel, and funds for the five-year period ending 1972-73. Other Assessment Groups visited Schools of Pharmacy, laboratories of federal government departments engaged in research related to the health sciences, and a number of pharmaceutical companies. The results of this phase of the Survey, and the recommendations of the Assessment Groups, recently published as MRC Report No. 2, will receive the close attention of Council as it reviews its programs and activities.

5. Powers and Programs

The responsibility of the Medical Research Council is to develop and support high quality research in the health sciences, and the powers of a corporate agency provided in the National Research Council Act have been very well suited to the task. Under the corporate agency form of administration there has been the possibility of a flexibility and economy which would be difficult

to achieve within a departmental structure. With the powers of a corporate agency, Council has been the spending authority for the funds appropriated to it by Parliament for the extra-mural support of medical research. With this authority there is possible the expeditious development of new programs and re-arrangements of old ones. Within the past three years, the Medical Research Council has instituted nine new programs and most of the others have subjected to major alteration.

Freedom to adjust its programs to meet new needs, and to take advantage of unusual opportunities, is one of Council's greatest assets and one that must be preserved if the best use is to be made of the funds available to it. The representative nature of Council and its Committees provides it with a sensitivity to these needs and opportunities that is essential to its operation. Council does not underestimate the degree of responsibility that this entails. Authority to exercise this responsibility ensures that it will be maintained.

6. Hindrances to Effective Performance

There are three difficulties in the effective performance of Council's functions at the present time. These are:

- 1) The temporary legislative basis on which Council exists;
- 2) An inadequate secretariat, and
- 3) Inadequate funds.

The Council hopes and anticipates that early legislation will be put forward to give it statutory powers similar to those it has enjoyed under the National Research Council Act, i. e. those of a corporate body with autonomy in the operation of its program, subject always to normal government controls.

The work of the Medical Research Council as reflected in the budget of the past five years has grown rapidly.

In actual fact the work has grown more rapidly than the budget because of the institution of many new programs which require large amounts of staff and committee time. With the increase in Council's responsibilities has come a considerable increase in the number of applications, and it should be remembered that an application for funds which may in the end be denied requires just as careful consideration as an application for funds which is acceded to. The secretariat has also had increasing responsibility for the administrative aspects of Council's operation which were previously carried out by the National Research Council.

The administrative budget is subject to the restrictions common to most government agencies at the present time but it must be stated that the situation causes real concern. If the distribution of the large amounts of money now involved is to remain wise and effective, there must be people to do the job.

Another major problem is the lack of funds to meet valid needs in the extramural program. This however must be recognized as a problem common to many agencies and needs no elaboration here.

7. Personnel Policies

Since the Medical Research Council does not undertake research in facilities of its own and has therefore only a small administrative staff, it relies almost totally on the National Research Council for such staff training and development assistance as is required.

On the other hand, of course, the Council does maintain an extensive Personnel Support Program in the universities. The function of that program is to train potential investigators and to support a limited number of highly qualified scientists in universities, hospitals and research

institutes. An additional number are also employed on projects supported through the Council's Grants Program. None of those so supported or employed can however be regarded as Medical Research Council "employees".

8. Distribution of Activities

The regional distribution of the funds available to the Medical Research Council for 1967-68 is shown in Table 1.

(a)
Regional
Pattern

Table 1. - Pattern of Expenditure, 1967-68	
	(\$ thousands)
British Columbia	1,638
Alberta	1,310
Saskatchewan	524
Manitoba	1,042
Ontario	7,181
Quebec	7,653
New Brunswick	6
Nova Scotia	517
Prince Edward Island	--
Newfoundland	--
Outside Canada (Fellowships)	398
General support.	231
<hr/>	
Total extramural program:	20,500

This distribution is related to the number and size of the medical schools in each province. Awards made under the Grants Program and the Personnel Support Programs, as well as under some parts of the Special Programs, are determined on merit in open competition and therefore the pattern reflects the number of good applications coming forward from each province.

In some of the Council's programs an attempt is made to keep the rich from getting richer and the poor poorer; these are referred to in section II, 8 (b).

The Medical Research Council has given a great deal of consideration to problems of regional disparity. There are two categories of regional problem: (b) Regional Development

- 1) the special problems of new medical schools, and
- 2) the special problems of weak disciplinary areas in established medical schools.

Several programs have been developed by the Council to attack these problems. Before going on to describe them, something should be said about the role of financial assistance in the support of research. It is necessary first of all to realize that money does not lead in these matters. Rather, money facilitates local leadership when it appears. Large grants go to an institution when it has collected a number of high calibre researchers; large grants going to an institution in advance of the acquisition of high calibre researchers may serve no purpose. Indeed, they may hinder the development of good research by permitting the continuation of the mediocre. At the same time it is to be remembered that an agreement about the provision of funds, if such a development takes place, may serve a very useful purpose.

Negotiated Development Grants - Negotiated Development Grants have as their chief purpose the facilitation of the recruitment of first class staff to the medical, dental and pharmacy schools. The type of application we prefer most is that which is concerned with the development of work in a field up till then relatively neglected in a given school. In such a situation, if a first class man or team were to be recruited, first class equipment available from the date of proposed appointment is almost always a condition of acceptance by the researchers concerned. Because it is an area in need of development, in such cases high class equipment of the type required has almost always been

lacking. Under such circumstances the Council is prepared to enter into an agreement with the university concerned that funds for equipment will be provided if the university is successful in recruiting the man or team in question. Both the researchers, and the equipment requested, are assessed independently by the Council.

Awards of limited duration may also provide for operating funds and for salary support for assistant staff and, occasionally, for the researchers. Normally only part of the total cost of the new research venture is covered by Negotiated Development Grants since the university itself is expected to be a contributing partner to the project.

During the present year, the four new medical schools have had first claim on half the \$750,000 devoted to Negotiated Development Grants.

General Research Grants - Every research operation of any size should at the beginning of the year have at its disposal funds not yet earmarked for any specific purpose. By and large, in our Schools of Medicine and of Pharmacy, such funds are not available in sufficient amount. The Medical Research Council has not attempted completely to repair this deficiency but it has recognized it and has made General Research Grants of \$24,000 per year to all medical schools and of \$5,000 per year to schools of pharmacy. It should be noted that in each category the same amount of money goes to each school.

Associateships - The Associateships program provides another mechanism for strengthening both geographic and disciplinary areas which are in need of development. These awards provide salary support for career investigators who have

already made their mark. While all those selected must be investigators of very high merit one of the criteria in evaluating applications is the contribution that the candidate is expected to make to the development of a weak area of research.

Grants Program - In the regular Grants Program, special consideration is given to applications from new faculty members. This means that there is some degree of special treatment given to newly recruited faculty members both in new schools and in those areas of the older schools where the universities have added to their strength.

Consultation Service - During the past two years the Medical Research Council has been asked on a number of occasions to provide advice concerning the development of research in specific situations. At times this has involved the assessment of a large situation and its possible development over a period of years. On other occasions Council has been asked to provide universities with its assessments of the potentialities of possible additions to faculty strength.

9. Personnel Associated with Scientific Activities

The total full-time staff of the Medical Research Council is now 16, five of whom are "professional" in the sense that they have university degrees. Three additional scientists are employed as consultants on a part-time basis.

All devote their time to administrative duties.

All the full-time professional personnel were born in Canada.

All took their university degrees in Canada:

Bachelor's	2
Ph. D.	1
M. D.	2

One of those with the M.D. degree subsequently obtained the D.Phil. degree from Oxford; both those with the M.D. degree are Fellows of the Royal College of Physicians and Surgeons.

The number of working years since graduation of the individual full-time professional personnel, exclusive of war service, are:

<u>Bachelor's</u>	<u>Ph. D.</u>	<u>M. D.</u>
26, 4	19	27, 29

One has worked for the Medical Research Council since it was established in 1960 (8 years); one was appointed in 1965, one in 1967 and two in 1968.

The average age of the professional staff is 46.

All members of the professional staff read French; two have some slight degree of proficiency in speaking French. One of the part-time scientists is completely bilingual and another is fluent in French (as is one member of the support staff). Every effort has been, and is still being, made to obtain the full-time services of a professional with a French background, so far without success.

Table 2. - Professional Staff by Degree Category

	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>
B.A.	1	1	2	2	1	1	2
Ph.D.	-	-	-	-	-	-	1
M.D.	(2)*	(2)	(2)	(2)	1 (1)	2 (1)	2 (3)

* Figures in brackets indicate part-time staff

From 1960 to 1965, the "professional" staff of the Council consisted of a Chairman and a Secretary, both part-time, and a full-time administrative officer. Following the death of the first Chairman, the present Chairman took up his appointment in Ottawa on a full-time basis; the Secretary continued to

be part-time until 1967 when his other commitments forced his resignation. The present Secretary and the other two professional staff members took up their appointments during this past year. One of the current part-time professionals held a full-time appointment with the Medical Research Council until recently taking up a senior university post.

The three senior professional personnel have been employed in universities, two for most of their careers to date. None have been employed by industry (except in a consulting capacity) or by provincial governments. Three transferred to the Medical Research Council from the National Research Council.

10. Expenditures Associated with Scientific Activities

The funds of the Medical Research Council are spent (a) in the support of medical sciences. The breakdown by function, Expenditures as defined by the Committee, is set out in Table 3.

Table 3. - Expenditures by Function							
	(\$ thousands)						
	62-63	63-64	64-65	65-66	66-67	67-68	(est.) 68-69
Data Collection	12	6	11	15	114	133	110
Scientific Information	26	18	23	25	26	75	132
R. & D. in Universities	3,882	4,626	6,222	11,445*	11,219	18,513	23,329
Higher Education	377	450	679	765	991	1,779	3,372
Totals:	4,297	5,100	6,935	12,250*	12,350	20,500	26,943

* Including Supplement of \$3,000,000 provided in 1965-66 for application to awards for 1966-67.

The Medical Research Council has made no capital expenditures. The expenditure of operating funds by units for the fiscal years 1962 to 1967 inclusive, and estimated expenditure for 1968-69, are set out in Table 4. In addition, we have shown the administrative costs of operating the entire program.

Table 4. - Operating Expenditures by Unit

	62-63	63-64	64-65	65-66	66-67	67-68	(est.) 68-69
	(\$ thousands)						
EXTRAMURAL PROGRAMS:							
Grants Program	3,429	3,957	5,179	10,134*	9,088	15,388	18,681
Personnel Support Programs							
Associateships	305	411	533	606	850	955	1,331
Scholarships	--	101	349	540	855	1,221	1,437
Fellowships	353	426	610	693	899	1,488	2,234
Centennial Fellowships	--	--	--	--	--	97	186
Studentships	--	--	--	--	--	--	725
Summer Scholarships	24	24	69	72	92	194	227
	682	962	1,561	1,911	2,696	3,955	6,140
Special Programs							
Visiting Scientists	4	13	17	21	44	206	294
General Res. Grants	144	144	144	144	336	336	424
Travel grants	18	4	10	14	8	20	30
Symposia	6	11	11	10	16	29	40
Surveys	1	2	1	--	69	102	20
Negotiated Development Grants	--	--	--	--	12	171	750
Groups	--	--	--	--	--	214	350
Visiting Professors	--	--	--	--	5	9	12
Clinical Trials	12	6	11	15	45	34	100
International Affil'ns	1	1	1	1	2	2	2
Cdn. Council on Animal Care	--	--	--	--	--	21	50
Chairman's Fund	--	--	--	--	29	13	50
	186	181	195	205	566	1,157	2,122
Total Extramural	4,297	5,100	6,935	12,250*	12,350	20,500	26,943
ADMINISTRATIVE COSTS							
	57	58	89	112	156	229	303
Grand Total	4,354	5,158	7,024	12,362*	12,506	20,729	27,246

* Including Supplement of \$3,000,000 provided in 1965-66 for application to awards for 1966-67.

11. Evaluation of Proposals

All requests for financial assistance directed to the Council are referred to one or other of its standing committees for assessment.

(a)
Peer
Assessment

Before going to the appropriate Committee, each application for an operating or major equipment grant is referred to external referees, i.e. experts in the field who are not members of a Council committee. Each application, and the external referees' comments, is then discussed in committee, a judgment is made of the scientific merit of the proposal and the validity of the budget proposed by the applicant, and a numerical rating is assigned to it. The ratings and recommendations of the Committees with respect to all applications are then forwarded to Council for final action.

To assist them in the assessment of applications the committees have before them the curriculum vitae of each applicant which indicates his training, his experience to date, and his publications; this enables the members of the committees to assure themselves of the applicant's competence to carry out the proposed project. Council also requires that applicants provide detailed information not only about the objectives of the proposed research but also about the manner in which it is to be carried out.

In making awards, the following policies of the Medical Research Council are adhered to:

- 1) principal investigators may not receive remuneration from operating grants;
- 2) those employed as assistants to the principal investigator may not be paid more than those of similar qualifications and experience who receive direct support through the Personnel Support Programs of the Council (e.g. Fellowships, Scholarships, etc.);

- 3) funds are not provided through MRC grants for the purchase of equipment for space eligible for support under the Health Resources Fund Act;
- 4) funds are provided for equipment that is essential to the proposed research but not for teaching or service work;
- 5) when applicable, adequate provision must be made for the maintenance and humane treatment of experimental animals;
- 6) when applicable, clinical research projects must have been evaluated and approved on ethical grounds by university committees convened for the purpose;
- 7) funds are not provided for overhead costs.

Applications in the various categories of the Personnel Support Programs are similarly processed by Committees. Copies of the full applications and supporting documentation are sent to the members for review prior to the meeting and are subsequently discussed. Recommendations are then forwarded to Council for final action. In assessing applications, care is taken to ensure that:

- 1) the candidate meets the high academic requirements of Council;
- 2) that the regulations of the particular program have been complied with;
- 3) that the department in which the award is to be held is able to provide the necessary facilities.

The proposals put forward under the Special Programs of the Council are reviewed by the Executive, in consultation with the chairmen or individual members of the appropriate standing committees if this is desirable, and recommendations are then forwarded to Council for its consideration and final action.

The priorities of various programs are assigned by (b)
Council. Council receives for this purpose inputs from the Priorities
Executive, the Grants and Selection Committees, the secretar-
iat and, on occasion, ad hoc committees. Priorities are assigned
to programs for a given year when the budget target for that year
is known. However the process is flexible and changes may be
made by Council during the course of the year.

Within programs, priorities are assigned to projects
for the most part by the Grants Committees, Selection Commit-
tees and the Executive. On occasion Council itself has re-arranged
priorities assigned by the committees to groups of projects within
a program. For example, it has at times said that applications
for operating grants from new faculty members are to receive
favourable consideration as compared with the applications from
established faculty members who have been given the same prior-
its ratings by the Grants Committees.

The most important part of the monitoring process (c)
takes place within Grants Committees when grantees apply for Monitoring
continued support of an on-going project or when they apply of Projects
for support for a new project. The assessment of previous
accomplishment is an important factor in the decision about a
new award or renewal of an old award, as has been noted in
para. a , page 37. The assessment of progress by Grants
Committees is based on published papers, submitted progress
reports and personal knowledge. When this basis may prove
to be inadequate for sound decision, an on site visit is arranged.
The visitors may spend one or two days in the laboratory con-
cerned, and in the selection of visitors an attempt is made to
combine both expertise in the special field and knowledge of
Council policies.

It may be remarked here that the standards applied are not only national but international. Referees are drawn from England and the United States as well as from Canada. Americans have frequently made on site visits for us. One of the Grants Committees has an American among its members. Several members of our Grants Committees work on comparable committees in the United States.

Renewals of Studentships and Fellowships are contingent on the receipt of satisfactory reports from supervisors. Scholarships, which are awarded in the first instance for three years, may be renewed for a further two years on receipt of a satisfactory report from the university and satisfactory assessment of the grant applications which the Scholar has submitted.

Associates are appointed initially for a term of three years and may receive renewals of their appointments for periods of five years. As each term expires, the Associate writes a report on his work, he is visited in his laboratory and all the information which Council has about his performance is brought together for committee review.

As has been indicated, priorities are assigned to programs in the light of funds available, and the assignment of priorities is essentially the decision to allocate resources. It is obvious that the most important part of a list of priorities is the bottom of the list. Only by deciding what is not to be done can funds be made available for that which should be done when resources are limited.

(d)
Implementation
of Priorities

The allocation of funds to projects within programs is directly related to the priority given to individual projects on the basis of their scientific merit.

Network methods are not used to plan and monitor projects. Expertise in the many special fields concerned is available in the Grants and Selection Committees, the referees and on site visitors.

(e)
Network
Methods

Decision to terminate research projects is made by the machinery described in para.(c) above. When such a decision has been made, a "terminal grant" is awarded. Terminal grants are for a period of 3 - 12 months and provide protection for the personnel involved during the period of readjustment. Both the terminal award rate and the rejection rate for new proposals are at comparatively high levels.

(f)
Termination
of Projects

Some years back the Medical Research Council lived within its budget by spreading its funds rather thinly among a very high percentage of applicants. Three years ago Council took the decision that high quality researchers should be funded not necessarily at the level they wished but at a level which would not put unreasonable financial barriers in the way of rapid progress of good work. This has meant, and it was known that it would mean, that the terminal award rate and the rejection rate would rise. One result has been the withdrawal or withholding of support from investigators of significantly lesser merit. Many of these investigators perform important functions in the training of graduate students and in the teaching of undergraduate students. Consideration is now being given to methods by which they can be provided with funds adequate to sustain modest research programs which are desirable complements to their teaching function.

Contributions to knowledge arising out of extramural research are transferred to points of use through the scientific literature, conferences and symposia. Within the institution, such contributions may of course immediately be put to work either in diagnosis or treatment or in the elaboration of further research. This however is only one of the benefits of extramural research to the institution in which it is carried out. Another, and not by any means a minor one, is the effect which the prosecution of good research by good people has on the diagnosis and treatment and teaching in that institution. For one thing, good researchers are at the edge of knowledge in their field, they are up to date. Aside from contributions they make to new knowledge, their possession of up-to-date knowledge and technology in their fields contributes to the scientific and technological level of the institution and hence to the level of diagnosis and treatment.

(g)
Transfer of
results

All the funds available to the Medical Research Council for its extramural program have been expended in each of the years 1962-63 to 1966-67.

(h)
Expenditure
of funds

Funds provided by the Medical Research Council in response to specific applications for grants-in-aid and for the support of the various categories of research personnel have for a number of years comprised approximately 95% of the total expenditures for the extramural program. The award rate for applications considered in each of the years 1962-63 to 1967-68 is shown in Table 5.

(i)
Award Rate

Table 5. - Award Rate, 1962-68		
Year	Grants Program	Personnel Support Programs
1962-63	63%	63%
1963-64	55%	67%
1964-65	59%	59%
1965-66	51%	59%
1966-67	69%	79%
1967-68	63%	55%

The sudden increase in the award rate for grants-in-aid in 1966-67 is the result of a \$3,000,000 supplement approved by Treasury Board in March 1966 to meet awards for 1966-67. The increase in volume and value of applications in the past two years, unaccompanied by a corresponding increase in the funds provided Council, has resulted in award rates similar to those in the early '60s.

It is difficult to arrive at a meaningful comparison of amounts requested and granted for the Special Programs. Most of the requests in this category relate to proposals outside the normal competitive programs of the Council and are not for specific sums of money but for such assistance as Council can provide. Other aspects of the program, such as the General Research Grants and the payment of dues in international organizations, are matters of Council decision rather than response to individual requests.

12. Research Output

Ten patents are known to have been obtained in recent years by investigators who hold MRC grants. The work which resulted in these patents was in some cases supported in part by other agencies as well. Only one of these patents has yielded any economic return as far as we are aware; royalties amount to some \$50,000 per year. The Medical Research Council does not claim patent rights to any inventions resulting from research supported by MRC funds.

(a)
Patents

In the quinquennium 1962-67 some thousands of scientific papers were published in some hundreds of journals by grantees of the Medical Research Council. Reference to publications exists in the individual file of each grantee and this is available to Grants Committees when they make their assessments. Not for almost 15 years has the information necessary to compile a complete master list been extracted from the individual files. It has not been possible for Council staff to prepare a list of the papers involved in time for the submission of this Brief.

(b)
Scientific
papers

In place of a list of publications arising out of research projects supported, Council submits copies of the booklet "Medical Research Council: University Support 1967-68", which contains the titles of the projects supported during that year. Work on all but a few of these projects gave rise to publications.

The Annual Report to Parliament of the Medical Research Council has up to the present time been included in that of the National Research Council.

(c)
MRC
Reports

For the benefit of the universities and prospective applicants, the Medical Research Council prepares annually an "Extramural Programme" booklet describing the various categories of support which it provides. "Medical Research Council: University Support", a list of all projects and personnel supported during the year, is also published annually.

The Council has recently started a "Report" series for the publication of material too lengthy for submission to the normal journals, and of the reports of its committees which would seem to be of widespread interest. This new series now includes three titles:

Report No. 1: "Survey of Research Personnel in the Medical
Sciences in Canada (Universities and Hospitals)
1965-66." 1966. pp. 33.

Report No. 2: "Canadian Medical Research: Survey and Outlook".
1968. pp. 416.

Report No. 3: "Health Research Uses of Record Linkage in
Canada." 1968. pp. 80.

Under its Special Programs, the Council is prepared (d)
to provide financial support for scientific symposia organized
by universities and international scientific meetings held in
Canada. A list of those supported from 1962 to 1968 inclusive
is given below:

1962-63: Western Regional Meeting on Medical Research.

1963-64: Western Regional Meeting on Medical Research.

International Symposium on Hypertension,
Ste-Adele-en-haut, Quebec.

1964-65: Symposium on the Use of Radioautography in
Investigating Protein Synthesis, Montreal.

Western Regional Meeting on Medical Research.

Symposium on Muscle, Edmonton.

1965-66: Symposium on the Regulation of the Antibody
Response, Toronto.

Symposium on Gastric Secretion, Edmonton.

Western Regional Meeting on Medical Research.

Symposium in Medical Engineering, Halifax.

1966-67: Symposium on the Biochemistry of Virus Infection
and Replication, Edmonton.

Conference on Biomedical Engineering, Ottawa
(jointly with NRC).

Western Regional Meeting on Medical Research.

International Symposium on Immunological Aspects
of Polymorphism, Quebec City.

- 1967-68: Symposium on Cellular Differentiation, Montreal.
- Third Parathyroid Conference, Mont Gabriel, Quebec.
- Symposium on Use of Animals in Medical Research, Kingston.
- Conference on Surgical Education and Research, Winnipeg.
- Bremer Symposium on the Cerebral Cortex, Montreal.
- Symposium on the Relationship between Basic Sciences and Clinical Medicine, Winnipeg.
- Conference on the Endocrine Aspects of Disease Processes, Montreal.
- Conference on Cold Physiology, Edmonton.
- Symposium on Anaerobic Bacteria, Montreal.
- International Congress on Allergology, Montreal.

The Medical Research Council itself has organized only one Conference and one Workshop, both in association with its ALS Project.

While Associates, Scholars and Fellows are not "employees" of Council it may be of interest to the Committee if we record that only one Associate has resigned his appointment to leave the country; he went to Hawaii. Two Scholars have resigned their appointments to leave the country, one an Englishman who went to the United States and the other, an American citizen, had to return to the United States for military service but is expected to come back to Canada. Holders of Medical Research Council Fellowships who go to the United States or Europe for part of their training have with very few exceptions returned to this country.

(e)
Departure of
trained
personnel

Information concerning the development of research teams and facilities during the past five years, and also an assessment of Canadian medical research output, is contained in MRC Report No. 2, "Canadian Medical Research: Survey and Outlook".

(f)
Research
teams and
facilities

13. Projects

The number of grants and personnel awards held during the years 1962-63 to 1967-68 were as follows:

(a)
Number of
Projects

Year	Grants	Fellow-ships	Scholar-ships	Associate-ships
1962-63	445	82	--	29
1963-64	499	107	11	35
1964-65	575	122	30	41
1965-66	728	128	50	46
1966-67	980	144	62	52
1967-68	1, 149	254	82	54

"Medical Research Council: University Support 1967-68"
(Appendix C) contains a complete list of projects supported during that year; a similar publication is available for the two preceding years, on request. Prior to 1965, the Medical Research Council did not itself publish an annual list but comparable information was included in an NRC publication.

The provision of project support by the Medical Research Council through its regular grants program follows a very similar pattern in the majority of cases. As reported in section 11 (page 37), applications submitted by the investigators are referred first to external reviewers, then to the relevant Grants Committees which send recommendations through the Executive to Council for final decision. Case histories 1 - 5 reflect this type of procedure. Some of the projects outlined are purely fundamental in nature, designed to add to knowledge and to provide opportunities for graduate students to learn the scientific method and its application.

(b)
Case
Histories

Other projects began as fundamental or basic research but led unexpectedly to new knowledge with direct application at the clinical level. Still others have, from the start, been applied research of the most immediate interest and utility.

The remaining four case histories present examples of special mechanisms which Council employs to meet special needs: to assist in the development of research in new medical schools or of research in a new area of an established school (on occasion in conjunction with other granting agencies), to initiate developmental work in areas where there is a need for organization and coordination on a nation-wide scale, and to provide opportunities for investigators of proven capability to work on an intensive program of research and graduate training within a university environment, but without the normal distractions of administrative and undergraduate teaching duties.

Case 1. - Dr. Claude Fortier, Director of the Department of Physiology and of the Endocrinology Laboratories at Laval University, is carrying out a series of studies on the mechanism of action of hormones. These studies have resulted in a number of original contributions to the understanding of the relationship between the pituitary, adrenal and thyroid glands, and man's metabolic adaptation to environmental stimuli. The investigation has recently been extended in a novel manner by the application of techniques thus far used mainly in the study of electromechanical feedback control systems. In collaboration with colleagues in the Department of Electrical Engineering and the Data Processing Centre at Laval, a mathematical model of the pituitary-adrenocortical complex is being developed to provide data for the computation of ACTH-induced changes in corticosterone secretion rate.

The Medical Research Council has supported this extensive and imaginative research program since it was initiated by Dr. Fortier

at Laval some ten years ago. Its primary contribution has been the provision of funds for technical assistance, materials and supplies, and support for graduate students, a number of whom have subsequently joined the faculty of Canadian universities as teacher-scientists in their own right.

Case 2. - Dr. J.S. Colter, who returned to Canada from the United States in 1961 to head the Department of Biochemistry at the University of Alberta, has been investigating cell-virus interactions. The overall program is divided into two parts, one which is primarily biological in nature and one which is chemical and physical. The objective is to provide an understanding, in molecular terms, of the differing biological properties of three variants of an encephalomyelitis virus which have been isolated and maintained as pure lines. A variety of sophisticated techniques including optical rotatory dispersion, ultracentrifugation, amino acid analysis, electron microscopy, chromatography and tissue culture are applied to these studies. This fundamental work is designed to elucidate the initial steps in the replication cycle of a virus and the reason why cells are susceptible or resistant to infection with a virus agent. The investigation has led to 12 publications in the past four years and provides excellent opportunities for the training of graduate students in modern biochemical and biophysical techniques.

The Medical Research Council has, for the past eight years, provided funds for technical and professional assistants, for expendable supplies, and for several items of specialized research equipment required for the study.

Case 3. - Dr. D.H. Copp of the Department of Physiology at the University of British Columbia has been studying bone metabolism for a number of years. The aim of the investigation

is to study the normal mechanism for blood calcium regulation and the relationship of the parathyroid hormones to it. The results obtained led to extensive revision of the existing theory of parathyroid action. With dogs and pigs as experimental animals, methods were successfully developed for raising and lowering plasma calcium levels; these methods were subsequently applied to patients with osteoporosis and Paget's Disease in a collaborative study with a clinical colleague. In 1961 the research led to the discovery of a new hormone, calcitonin, which lowers blood calcium and controls hypercalcemia. Considerable work since that time has been devoted to the purification and characterization of this new hormone, the development of dose vs. response relationships, the study of the effect of changing calcium levels in the production of calcitonin by the thyroid and parathyroid glands, the development of bioassay methods to measure its concentration and to determine its rate of production under varying conditions, as well as to other related studies.

This project began in 1950 with a modest grant of \$5,050 for the salary of a technician, and a student assistant during the summer months, and for animals and expendable supplies. As the work progressed, further funds were provided for the employment of a second technician, for the stipends of two graduate students working towards the Ph. D. degree under the supervision of the investigator, and for the half-time services of an animal attendant. Following the discovery of the new hormone, the Council was asked, and agreed, to increase the grant to provide for the salary of a qualified biochemist to purify and characterize it, and for items of special research equipment required to do this. The project is being continued vigorously and with originality with a view to the use of calcitonin in the treatment of certain disease states; the investigator himself is recognized internationally as a leading authority in his field.

Case 4. - Dr. Jacques Genest and his group, now at the Clinical Research Institute of Montreal, have for many years studied the relationship between the adrenal cortical hormones (especially aldosterone) and hypertensive cardiovascular diseases in man. The investigation has also included research into the relationship between the kidney and human hypertensive diseases. It has been possible to differentiate between various types of human hypertension and thus to determine the most appropriate means of management and treatment. A number of methods of steroid measurement have been devised by Dr. Genest and his colleagues and many new antihypertensive and natriuretic agents have been investigated. An important feature of the program is the metabolic balance studies on normal subjects and selected patients with arterial hypertension, renal disease, and endocrine disorders. These studies are carried out in special facilities which make it possible to measure precisely dietary intake and to determine accurately the excretion of electrolytes and other body constituents; the availability of these facilities has also made it possible to define with more precision the criteria for the success of surgery in patients with hypertension associated with renal artery obstruction, and to investigate renin activity in some physiological and pathological states.

The Medical Research Council has supported Dr. Genest's program since 1950 and has, within the limits of its resources, increased the funds provided because of the withdrawal, for policy reasons, of support by the Department of National Health and Welfare and the American government. In addition to funds for expendable supplies and materials, the Council has provided substantial sums for research equipment and for the salaries of specialized personnel required to maintain the Metabolic Unit

and the costs of "hospitalizing" for short periods normal volunteers required for control studies. Dr. Genest has been responsible for the research training of a large number of clinical Fellows, many of whom have been recipients, in competition, of Medical Research Council Fellowships. Two members of the research team are supported by MRC Associateships. The Council has also contributed to the support of an international symposium on hypertension organized by Dr. Genest which was attended by other world-renowned workers in the field from England, the United States, Switzerland, Sweden, France and South America.

Case 5. - Dr. T.M.S. Chang of the Department of Physiology at McGill University is investigating methods of counteracting enzyme deficiencies. Enzymes in nature are commonly encapsulated within small aqueous compartments - cells or subcellular organelles - whose limiting membranes prevent their escape but are permeable to the smaller molecules of their substrates and products. A method has been developed for producing artificial microcapsules of comparable dimensions and properties and loading them with enzymes and other proteins without loss of their biological activity in vitro or in vivo. To overcome the practical problems of injecting the semipermeable microcapsules into the body and their subsequent accumulation there, an extracorporeal shunt chamber has been devised through which blood from an artery can flow, come in contact with the enzyme-loaded microcapsule, and then be returned to a vein. To avoid possible clotting of blood while preserving the activity of the encapsulated enzyme, the microcapsules are made of nonthrombogenic collodion. Experiments are continuing 1) to

test the feasibility of using microcapsules containing urease in the design of a compact artificial kidney which, theoretically, need be no larger than 10 cm. in length and 2 cm. in diameter; 2) to study the use of microencapsulated catalase for the therapeutic replacement of enzymes in deficiency diseases; 3) to investigate the effect of microencapsulated asparaginase in the treatment of leukemia, and 4) to study the use of microencapsulated detoxicants to remove permeant toxins from blood, for example in cases of barbiturate or acetylsalicylic acid poisoning of children.

Dr. Chang first conceived this novel project while holding a Medical Research Council Fellowship under the direction of Professor F. C. MacIntosh at McGill. When Dr. Chang joined the staff of the university, he applied for and received MRC funds for the salary of a technician and a graduate student taking advanced training under his direction, for expendable materials and supplies and for experimental animals. The potential of this invention is being carefully and systematically developed and the research can be expected to have important applications in a number of clinical areas.

Case 6. - Early in 1968, the new medical school at the University of Sherbrooke had an opportunity to add to its faculty a well qualified teacher-scientist, born in France but then working in the United States. In order to be able to assure this prospective new recruit of funds for the early re-establishment of his research program in the new location, the University applied to the Medical Research Council for a Negotiated Development Grant to be provided if the scientist in question did in fact accept the appointment offered him. This application involved assurance by the University of suitable facilities and the necessary equipment,

as well as the submission of a detailed research proposal, budget and the curriculum vitae and publications of the investigator himself. Following review of this material by Canadian scientists expert in the field, an undertaking was made to provide funds for the project and for the support of three graduate students for a specified period. The appointment was subsequently accepted and the funds were made available to the University.

This case history is presented as an example of the support provided through the Negotiated Development Grant program, which enables Council to assist universities to take advantage of opportunities as they arise, without the necessity of waiting for sometimes prolonged periods and thus running the risk of losing potential faculty. This problem is particularly acute in French Canada where high standards of scientific and teaching ability must be matched with a working knowledge of French. Once their research programs are under way, those receiving initial support through the Council's special program are expected to seek support for the continuation of their research through the regular programs of the Medical Research Council or other agencies.

Case 7. - Two years ago, McMaster University was negotiating with a Canadian-born scientist, then working in a well-known research Institute in the United States, whom it hoped to attract to the chairmanship of the Department of Biochemistry of its new medical school. The research interests of the scientist demanded continued access to a high resolution mass spectrometer, costing some \$173,000, to be used in studies of nucleic acid structure and function with a view to increasing our understanding of the molecular mechanisms of cell differentiation such as takes place in embryonic development, budding in plants, and the

transformation of cells from normal to malignant. The equipment was needed too for studies in organic chemistry to be undertaken by investigators already on the staff of the Department of Chemistry of the University. Application was therefore made to the Medical Research Council and the National Research Council for the funds to purchase the equipment.

Following detailed review of the research proposals put forward and an on-site visit to the University by a group of scientists to explore the situation, the Medical Research Council undertook to provide half the cost of the spectrometer on the understanding that the funds would be provided only if the investigator in question accepted the proffered appointment in the medical school and the balance of the funds were obtained from other sources. The National Research Council subsequently agreed to make a very substantial contribution and the university to pay the remainder. The appointment was accepted, the research program is now well under way, and the availability of this special facility has no doubt had its effect in attracting other faculty members to the new medical school.

Case 8. - In 1966 the Medical Research Council announced that it was prepared to support the establishment and maintenance of research Groups within the framework of medical schools in Canadian universities. The group program is designed to provide financial support for groups of two or more outstanding investigators over a period of years in what appear to be especially productive fields of medical research.

A number of proposals were submitted by the universities and in March 1967 an agreement was reached with the University

of Montreal for the establishment of an MRC Group for the Neurological Sciences under the direction of Dr. H.H. Jasper, a neurophysiologist of international reputation. The senior personnel of the Group, in addition to Dr. Jasper, are highly qualified investigators in neurophysiology, neuroanatomy, neurochemistry, and biomedical engineering. Together they are carrying on an intensive interdisciplinary study of the organization of the nervous system. Many aspects of the problems of brain diseases and disorders, including epilepsy, are also being studied.

Under the terms of the agreement with the university, the Council's support of the Group covers the salaries of several of the investigators, their professional assistants, graduate students, technicians and other personnel, and the costs of supplies and equipment. The university, in its turn, has freed the members of the Group from the ordinary administrative and undergraduate teaching responsibilities of a member of faculty, and it has provided some 6,000 square feet of research space for the Group.

The initial period of Council's support is for five years, during the last of which the agreement will be re-negotiated with the investigators and the university.

By means of the Group program, the Medical Research Council expects that opportunities for productive research and training programs of high calibre will be increased in Canada, and it looks forward to the establishment of further Groups as suitable proposals are presented. This mechanism reflects Council's policy to assist and promote research in universities rather than to establish central laboratories. It permits highly qualified scientists to devote themselves to research and at the same time to contribute to the development of the graduate teaching program of the universities.

Case 9. - Studies in many laboratories, both here and abroad, on mice and other animals including non-human primates have indicated that some kinds of antilymphocyte serum prolong graft survival. A number of centers have begun using ALS in the treatment of transplant patients since it appears to reduce the need for administration of undesirably high dosages of other immunosuppressive drugs. Since it has not yet been definitely proved that ALS does play an effective role in inhibition of graft rejection in man, the Medical Research Council established in 1967 an ad hoc committee to study the problem and to consider what role, if any, the Council should play in the production and clinical testing of ALS in Canada.

Following careful review of existing knowledge, of the problems (both statistical and scientific) involved, and of Canadian capability in the vaccine field, the Committee recommended to Council that it sponsor the production according to a specified procedure of antilymphocyte serum to be made available to qualified clinicians in Canada who would undertake to participate in a nation-wide collaborative trial of its effectiveness in kidney transplants. This recommendation was approved by Council and all Canadian medical schools were invited to send representatives to Ottawa to discuss with the Committee the implementation of the proposal. A group of some 60 investigators and clinicians attended this Conference in May 1968. The ALS Project was enthusiastically received and Council was assured of the collaboration of all the major centers in which kidney transplants are being carried out. Arrangements were then made with the Institute of Microbiology and Hygiene in Montreal and the Connaught Medical Research Laboratories in Toronto to produce a single pool of serum according to the procedure developed by

the Committee in collaboration with scientists at these two production centers.

The Conference was followed by a four-day Workshop in September, 1968. This was attended by some 90 basic scientists and clinicians, and the technicians and data processors who would assist them in the actual operation of the Trial in the various centers. At the Workshop, the special techniques required were taught and practised in laboratory sessions, and lectures were given on various scientific aspects of the Trial. The "faculty" was comprised of senior investigators from Canada, the United States and The Netherlands expert in the fields of immunology, tissue typing, and computer processing of clinical data. The actual working methods to be used in the Trial centers have therefore been standardized and this should contribute greatly to the accumulation of comparable data.

The Project is a complex affair involving studies of methods of production of the serum, basic laboratory work concerned with potency, effectiveness and safety, as well as the complex national Trial itself. Council has sought, and obtained, the collaboration of a number of investigators who have undertaken some of the most immediate research problems, and the Radiobiological Institute of The Netherlands has generously agreed to carry out pre-clinical tests of the Canadian sera in chimpanzees since the necessary primate facilities are not available in this country. These tests are now in fact under way and it is hoped that the Trial itself can be started within the next few months.

The Project has received international attention since it represents the first attempt at a nation-wide trial of ALS as a

therapeutic agent. That it has aroused the interest of those working in the field in Canada is evident from the fact that participants in both the Conference and the Workshop attended at their own expense and investigators at the Royal Victoria Hospital, the Toronto Western Hospital and the Hospital for Sick Children, as well as at the Institute of Microbiology and Hygiene and the Connaught Medical Research Laboratories, have given freely of their time and effort in assisting Council in the achievement of its objective.

APPENDIX A

Members of Medical Research Council

- G. Malcolm Brown, M.D., C.M., D.Phil., F.R.C.P., F.R.C.P.(C)
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McGill University and Physician-in-Chief, Royal Victoria
Hospital, Montreal
- L. Berlinguet, D.Sc.; Vice-Dean, Faculty of Medicine (Research
and Graduate Studies); Chairman and Head, Department of
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- R.V. Blackmore, D.D.S., Ph.D.; Professor of Operative Dentistry;
University of Alberta, Edmonton
- G.E. Connell, B.A., Ph.D., Professor and Chairman of the
Department of Biochemistry, University of Toronto, Toronto
- A.D. Dickson, M.B., B.Ch., B.A.O., M.D., M.A.; Professor and
Head, Department of Morphological Sciences; University
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- S.M. Drance, M.D., F.R.C.S. (Eng.), M.B., B.S., Professor,
Department of Ophthalmology and Coordinator of Ophthalmic
Research, University of British Columbia, Vancouver
- J.R. Evans, M.D., D.Phil., F.R.C.P.(C), Dean of Medicine and
Principal of College of Health Sciences, McMaster University,
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- J.D. Hatcher, M.D., Ph.D., Professor and Chairman of the
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- L. Horlick, B.Sc., M.D., C.M., M.Sc., F.R.C.P.(C), Professor,
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- A.M. Hunt, D.D.S., D.D.P.H., M.Sc.D.; Director, Division of
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- J.M. Leclair, M.D., F.R.C.P.(C), F.A.C.P., Dean of Medicine
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- J.-P. Lussier, D.D.S., Ph.D., F.A.C.D.; Dean, Faculty of Dentistry
and Director of Studies; University of Montreal
- B.E. Riedel, Ph.D., Dean of Pharmacy, University of British
Columbia, Vancouver
- K.B. Roberts, M.A., D.Phil., (Oxon.), M.B., B.S. (Lond.);
Associate Dean for Basic Medical Sciences; Professor of
Physiology; Memorial University of Newfoundland
- R.B. Salter, M.D., M.S., F.A.C.S., F.R.C.S.(C), Surgeon-in-Chief,
The Hospital For Sick Children, Toronto

Special Committee

- H.B. Stewart, M.D., Ph.D., Professor and Head of the Department of Biochemistry, University of Western Ontario, London
- J.C. Szerb, M.D., Chairman of the Department of Physiology and Biophysics, Dalhousie University, Halifax
- G. Tremblay, M.D., Professor and Chairman, Department of Pathology, University of Montreal, Montreal
- J.C. Wilt, M.D., M.Sc., F.A.C.P., Professor and Head of the Department of Medical Microbiology, University of Manitoba, Winnipeg

APPENDIX B

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Appointments pending.

Psychology

Appointments pending.

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Membership re-constituted each year, depending on nature
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